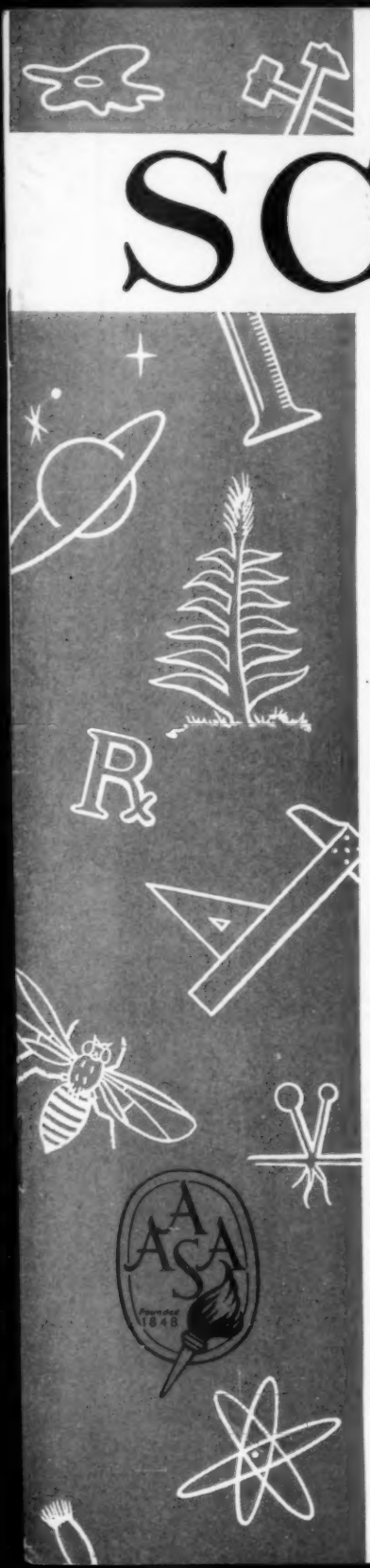

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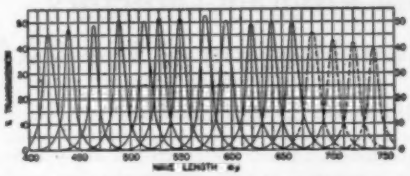

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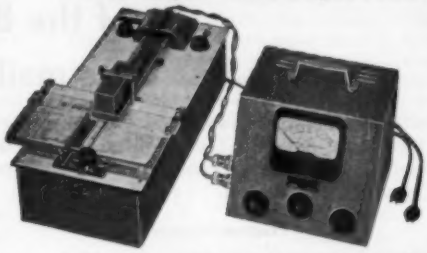

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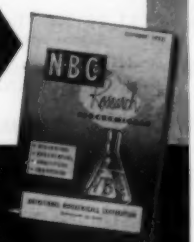

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5. Details of the Gymnasium for Men—center of the Meeting—and campus.
6. Titles of the latest foreign and domestic scientific films to be shown in the AAAS Science Theatre.
7. Exhibitors in the 1954 Annual Exposition of Science and Industry and descriptions of their exhibits.

Directory content

1. AAAS officers, staff, committees for 1954.
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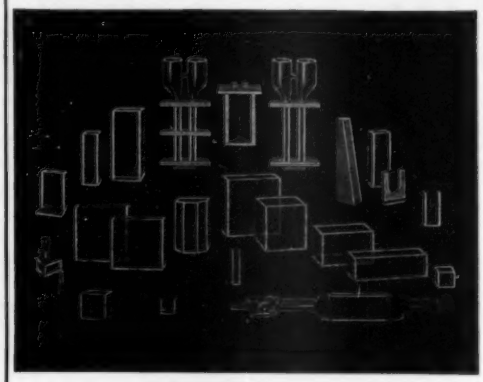

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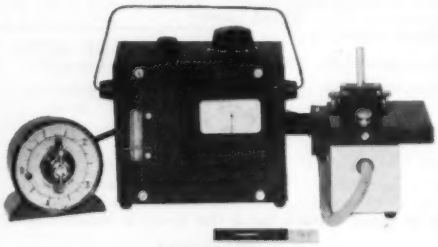

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National Speleological Society

CAVES have always held an almost mystical fascination for the average human being to whom the word *cave* immediately brings to mind a mysterious, subterranean chamber whose exploration is fraught with danger in dark, narrow passageways, rock breakdown, underground streams, and attacks from all sorts of animals ranging from bears to bats. Partly as a result of this feeling and, paradoxically, partly as a means of dispelling some of the aforementioned misconceptions, the National Speleological Society was formed in 1941. It is a nonprofit organization interested in the study and exploration of caves and allied phenomena. Originally the N.S.S. consisted of a group of amateurs as far as the field of cave science was concerned but whose energies were devoted to unlocking the secrets of the underground world. When this group, filled with an enthusiasm that is still prevalent in the society today, attempted to obtain information concerning the location, topography, and flora and fauna of caves, they found that little information was available for caves of the United States. In contrast to the many contributions made to science by European speleologists, not much had been undertaken in this field in the United States apart from studies made in some of the commercial caves.

As a result of projects undertaken by the N.S.S. in the fields of cave mapping, mineralogy, archeology, and biology, scientists who specialized in these subjects were attracted to the society, so that at the present time approximately half of the almost 2000 individual and institutional members are men of science whose fields of study and research are related to speleology. The remainder of the membership is made up of persons who devote their leisure time to locating new caves, developing new techniques of exploration, and gathering data from both new and well-known caves. These data are registered on a comprehensive four-page cave field report that is forwarded to national headquarters in Washington and a duplicate is retained for local files. In this manner, the society serves as a central agency for the collection, preservation, and publication of scientific, historical, and legendary information pertaining to speleology.

The affairs of the N.S.S. are controlled by a board of governors that appoints the national officers. These officers supervise the administrative and scientific functions of the society. Some of the more prominent activities now completed or under way include: (i) state surveys of caves with maps and descriptions of caves in Texas, Pennsylvania, Maryland, and West Virginia already published; (ii) a program of cave safety featuring lectures and articles on first aid, proper use of ropes, organization of expeditions, and underground communication; (iii) a cave conservation committee working vigorously for the preservation of the wildlife and geologic formations found in caves; (iv) continuation of a bat-banding program initiated to study the life-history and migration of bats.

The N.S.S. is divided on a regional basis into some 40 Grottoes whose members assume responsibility for all speleological activities in their area. This gives the individual member an opportunity to participate in expeditions studying larger caves that could never be explored by one or two persons. The experience gained from local studies is useful in large-scale expeditions, such as the recent week-long survey of Crystal Cave in Kentucky. All members receive the *N.S.S. News*, a monthly publication; *The American Caver*, an annual devoted to papers of a scientific nature; and *Occasional Papers*, a series of technical articles dealing with speleology.

The National Speleological Society has been fortunate in having men eminent in the fields of geology and natural history to act as its presidents. Currently the president is William E. Davies of the U.S. Geological Survey and author of *Caves of Maryland* and *Caves of West Virginia*.

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Radio Observations of Meteors

Peter M. Millman

Dominion Observatory, Ottawa

IT is a well-known fact that, when a meteoroid enters the earth's atmosphere at high velocity, a portion of the kinetic energy is expended in creating large numbers of ions along the path of the meteor. The long thin column of ions rapidly expands and diffuses and is distorted by the winds of the ionosphere until it eventually disappears. This meteoric ionization may serve as a radio target, and it thus makes possible a new method of studying both the astronomical properties of meteors and the physical conditions in our upper atmosphere.

At the close of World War II, a considerable quantity of powerful radio equipment was available for fundamental scientific research, and this fact was largely instrumental in promoting studies in radio astronomy. The serious application of radio methods in meteoric astronomy may be dated from the great Giacobinid meteor shower of October 1946. The radio results obtained on this occasion were so conclusive that world-wide interest was aroused in the potentialities of radio techniques, and these have now become an important division of the research in this field.

It is not the purpose of this paper (*1*) to deal with the history of this development, nor does it describe in any detail the various, and often ingenious, types of equipment devised by the radio engineers. The theoretical treatment of meteoric ionization and its effect on the ionosphere is a subject that, at the moment, is being actively pursued by a number of investigators, but it is too early to give a satisfactory survey of the basic theoretical conclusions. Rather, this paper is a brief summary of the most significant observational results secured through radio studies of meteors during the last 7 years. The origin of the results is indicated by references to some of the representative papers.

Although research publications dealing with this subject have appeared in approximately ten countries, the major effort has been restricted to three—England, the United States, and Canada. Observers have, in general, used wavelengths in the 1- to 100-m range, with either pulsed or continuous wave transmission on powers up to 400 kw. The aerial systems employed have been both beamed and nondirectional. In the early days of these observations, the radio results were recorded by visual monitoring, but this method has gradually given way to automatic photographic recording. Meteor echoes have, as a rule, been recorded either as an amplitude-time presentation or as a range-time presentation. Range is defined as distance from the observing station. The observational data are summarized under various headings.

Rates. The number of meteors recorded by radio in a given time varies considerably with the wavelength used and the various parameters of the transmitter-receiver system. The problem of rates is a very complicated one. Broadly speaking, the meteor rate per hour varies directly as the square of the wavelength, directly as the square root of the peak transmitter power, and inversely as the square root of the minimum echo power detected on the receiver, but there are many other factors that must be taken into account (*2*).

Typical rates range from 5 to 10 meteor echoes/hr for medium-powered equipment working on a wavelength of 4 m, up to 500 to 1000 echoes/hr for high-powered equipment working on a 10-m wavelength (*3*). In the case of the shorter wavelengths, these normal rates may increase by factors up to 10 at the times of the annual meteor showers and by factors up to 1000 at the peaks of the more exceptional showers, such as the Giacobinid meteor shower of 9–10 October 1946 (*4*). It is probable that the faintest meteors generally recorded by radio methods on the longer wavelengths are around the 9th or 10th visual magnitude, in other words about one one-hundredth the brightness of the faintest meteors normally seen with the naked eye. Estimates indicate that between 10,000 and 100,000 of these radio meteors enter the earth's atmosphere every second.

From an analysis of the radio meteor rates observed on wavelengths near 10 m, it is evident that, at the time of the well-known annual meteor showers, the faint meteors do not show the same increase in rates as do the brighter visual meteors. This confirms a conclusion, already reached from an analysis of visual observations, that the meteor showers are relatively rich in the bright meteors but have lost most of the smaller particles that correspond to the meteors visible only in telescopes or by radio.

Heights. The height of meteoric ionization has been measured in a number of ways. In England, a range record is combined with a determination of angular elevation of the echo above the horizontal plane (*5*). The measurement of elevation is made by comparing the strength of the signal received on two horizontal antennas mounted at different elevations above the ground. In Canada, a three-station setup has been used, the range being determined from each station, and the height being found by a straightforward solution of the triangles involved (*6*). Methods involving the combination of visual and radio data have also been used at a number of places.

The average heights found by the different methods agree remarkably well. There is little dependence of height upon the absolute brightness of the meteor, but

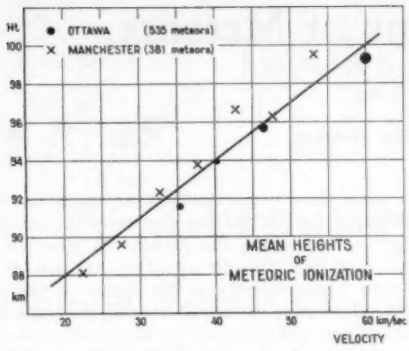

Fig 1. Mean heights of meteoric ionization.

there is a marked variation of mean height with meteor velocity. Combining more than 900 heights determined in England and Canada (*7*), we find the mean values plotted in Fig. 1. It is seen that the height for meteors moving at 60 km/sec is 100 km. This decreases linearly with velocity down to a height of 88 km for meteors with a velocity of 20 km/sec. Almost all meteoric ionization occurs in the height range of 70 to 120 km.

Velocities. It has been shown theoretically (*8, 9*) that the intensity of the radio wave reflected from the lengthening column of ionization formed by a meteor varies with a frequency dependent upon the meteor velocity and the geometry of the meteor path in relation to the observer. This amplitude variation of the received signal is usually in the audio-frequency range and has been termed the "meteor doppler whistle." It may be expressed by an equation involving Fresnel integrals and is most easily observed near the t_0 point, that is, the point where the meteor is moving perpendicularly to the line of sight. This amplitude variation can be photographically recorded and, if the range of the meteor is determined from a simultaneous range-time record, it is possible to compute the meteor velocity.

In England, a pulsed transmitting system has been used, and under these conditions the "whistle" is observed in increasing pitch after it has passed the t_0 point (*10*). In the United States and Canada, the reflected wave from a CW transmitter has been combined in the receiver with a direct ground wave, and the resulting "whistle" can be observed both before and after the meteor has passed the t_0 point (*9*). For meteors where the echo has considerable detail, it has been shown that the velocities and, in some cases, the decelerations can be measured from the range-time record alone (*11*).

Some 13,000 radio meteor velocities have now been published, approximately 11,000 in Canada and 2000 in England. The over-all velocity distributions from both sets of results, plotted in 5-km/sec steps, are illustrated in Fig. 2. They are almost identical, with velocity peaks near 37 and 60 km/sec and a mean velocity of 45 km/sec.

A number of different assumptions concerning the statistical distribution of meteor orbits in the solar system can lead to a distribution of observed velocities similar to that shown in Fig. 2, but it is still too early to draw firm conclusions (*9, 12*). Of particular significance is the fact that, within the limits of the experimental errors of these data, there are no velocities that definitely exceed the parabolic limit—that is, the upper limit of velocity that is possible for permanent members of the solar system. The radio observations take us down to objects roughly 1 mm in diameter.

Good statistical velocities have been determined by radio for nine meteor showers (*13*), and the observed frequency distributions of velocities are illustrated in Fig. 3. Four of these velocities are for daytime showers, first discovered by the English group at Manchester. Radio methods of radiant determination for meteor showers have been developed both in England (*14*) and Canada (*15*). The observed radiants (*16*) and the observed mean geocentric velocities are listed in Table 1. It must be remembered that visual or photographic observations are not generally possible in the case of the daytime meteor showers. Statistical velocities found by nonradio methods for the Perseid and Geminid showers (*17*) agree closely with the radio results.

Orbits. By combining the radio velocities with the corresponding radiants, it is possible to compute mean orbits for the various groups of meteors (*18*), and the elements of these orbits are listed in Table 2. In the case of some large meteors, it is possible to make a radio determination of the orbit of the individual particle (*19*). Except for the Perseid shower, these radio orbits are all of short period, 1.5 to 7.2 yr, and high eccentricity, 0.74 to 0.96. All but the Perseids and the Quadrantids have fairly low inclinations.

Wind velocities. At Stanford University and at the University of Manchester, the radio reflections from meteors have been used for determining statistically

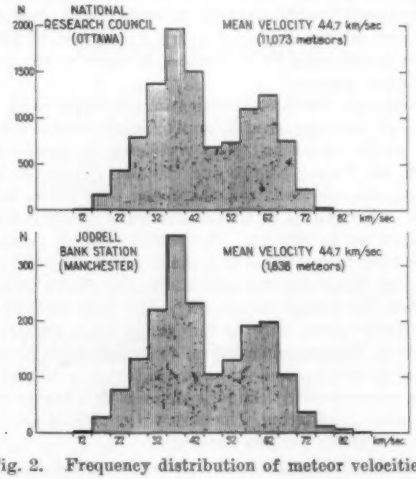

Fig. 2. Frequency distribution of meteor velocities.

the average ionospheric wind drift (*20*). Individual wind velocities of 50 m/sec in a horizontal direction and up to 10 m/sec in a vertical direction are normal. The average horizontal drift is 25 m/sec with a negligible vertical drift.

Ionospheric stratification. Evidences of fine structure or stratification in the ionosphere appear in the radio observations of meteors. The complex, long-enduring echoes usually show a series of discrete echoing ranges (*15*). The frequency distribution of the height of meteor echoes determined at Ottawa shows detail in the form of a number of submaxima. The spacing of the more marked features of this fine structure has a height difference of about 5 or 6 km and may have some statistical significance. It is similar to the preferred heights or fine structure for ionospheric reflections reported in connection with low-frequency recordings of the ionosphere (*21*). It is hard to escape the conclusion that the differential wind motions of the ionosphere, clearly evident in the long-enduring visual meteor trains, have a marked effect on the fine structure characteristics of the upper atmosphere.

Summary. To summarize, we find that the radio technique of meteor observation enables us to extend the systematic recording of meteor rates down to the 9th or 10th magnitude; to determine satisfactory heights and velocities on a scale previously impossible;

Table 1. Radiants and velocities of meteor showers.

Shower	Maximum	Radiant α	Radiant δ	Velocity (km/sec)
Quadrantids	3 Jan.	231°	+51°	40.9
o Cetids (D)*	19 May	29	− 3	36.8
ζ Perseids (D)	8 June	62	+23	28.9
Arietids (D)	8 June	44	+23	38.0
β Taurids (D)	30 June	86	+19	31.4
δ Aquarids	29 July	340	−17	40.3
Perseids	12 Aug.	45	+57	60.5
Giacobinids	10 Oct.	267	+56	22.9
Geminids	12 Dec.	113	+32	35.3

* (D), daytime showers.

Table 2. Radio orbits of meteor showers.

Shower	a*	P*	e*	i*	Ω*	ω*
o Cetids (D)†	1.3	1.5 yr	.91	34°	238°	211°
Geminids	1.4	1.7	.89	23	261	325
Arietids (D)	1.5	1.8	.94	17	77	29
ζ Perseids (D)	1.7	2.2	.80	1	77	61
δ Aquarids	1.7	2.2	.96	27	305	154
β Taurids (D)	2.4	3.7	.86	7	278	245
Giacobinids	3.5	6.6	.72	31	196	172
Quadrantids	3.7	7.2	.74	70	283	173
Perseids	(15)	(60)	.93	114	140	153

* Orbital elements: a, semimajor axis in units of earth's mean distance from the sun; P, period in years; e, eccentricity; i, inclination of orbit to ecliptic; Ω, longitude of ascending node; ω, angle from ascending node to perihelion.
† (D), daytime showers.

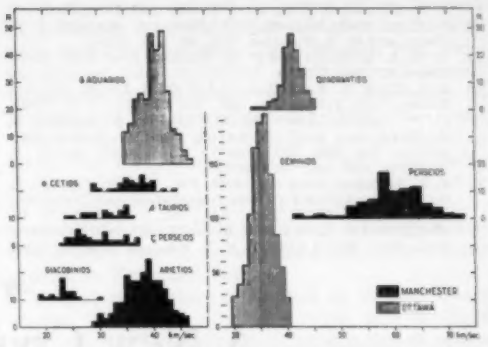

Fig. 3. Radio velocities of meteor showers.

to calculate the orbits of meteor showers and individual meteors, in particular those that appear only in the daytime; and to study wind drift and fine structure in the ionosphere. The radio observations have quite definitely indicated that down to the 9th magnitude, corresponding to particles approximately 1 mm in diameter, meteors are members of the solar system and do not come from interstellar space.

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A New Crystalline Silica

Paul P. Keat*

School of Ceramics, Rutgers University, New Brunswick, New Jersey

A STUDY (*1*) of the role of soda in the crystallization of amorphous silica under hydrothermal conditions has uncovered a new crystalline form of silica. The new phase has characteristic physical properties different from the other known forms of silica. Its occurrence in nature is not known. The resemblance of a crystalline "intermediate" in the formation of low-cristobalite from silicic acid, reported by J. Endell (*2*), has been noted and is further discussed here.

The hydrothermal conditions of formation of the new phase were produced with equipment patterned after Morey's (*3*). The reaction vessel was a Morey-type autoclave with an internal volume of approximately 20 ml. Platinum or silver crucibles, with covers, held the reactants within the autoclave. To furnish pressure, distilled water was compressed by a high-pressure hydraulic pump and delivered to the autoclave through standard high-pressure metal tubing. The pressure was maintained at desired levels by electronic controls. Heating was accomplished by surrounding the autoclave with a Nichrome-wound furnace, also controlled electronically. The gage-pressure and temperature ranges within which the new silica was synthesized were 5000 to 18,000 lb/in.^{2} and 380° to 585°C. These limits, for the most part, were set either by the equipment or by the relative sluggishness of reaction (at the lower temperatures and pressures) and, therefore, do not define actual limits between which the new silica may be synthesized.

The initial material in the majority of experiments was Merck's "analytical reagent silicic acid." Silica gel formed by the hydrolysis of tetraethyl orthosilicate was also used successfully. To this, in a platinum (or silver) crucible, was added a small amount of alkali. Distilled water was used to fill the crucible, the cover was adjusted, and water was added to fill the reaction chamber completely. The alkali was added as NaOH, KOH, LiOH, Na_2WO_4, and as the carbonates of the same metals, all in solution form. The amount added was extremely small, for example, 1 ml of 0.0100*N* NaOH solution.

The concentration of base is fairly critical, because too small an amount will cause the formation of cristobalite and too large an amount, the formation of quartz. The actual concentration in contact with the silica is not known exactly, because the distribution of water in the apparatus is so dependent on the temperature. The amount of silicic acid was not a vital factor; generally, approximately 1.5 g was used as determined by the capacity of the crucibles used. Synthesis of the new silica was effected in more than 70 experiments; conversion under optimum conditions was, in general, complete. However, crystal development usually was quite poor, the product being cryptocrystalline in appearance. Only a small proportion of experiments yielded crystals of sufficient quality for optical analysis. This strong tendency to form submicroscopic crystals may well account for its lack of recognition in nature. Identification of such crystalline aggregates in some reaction products, by means of refractive index, yielded a range of values extending from 1.501 to approximately 1.508, and also from 1.528 to approximately 1.535. These differences in index resulted from the presence of intermingled, very small crystals of either cristobalite or quartz, as determined by x-ray analysis. This effect of an "average refractive index" for an aggregate has been noted before (*4*). Consequently, another reason why the new silica may have been overlooked in nature is the lack of distinguishing features by virtue of the poor crystalline development; it may even have been identified as, or with, another phase—perhaps, as a "microcrystalline variety" of silica.

Both spectrographic and chemical analysis show the reaction product to be a very pure silica. It is completely soluble in cold hydrofluoric acid. The major impurities, Na_2O, Fe_2O_3, and Al_2O_3, are present in a concentration of less than 0.01, less than 0.02, and less than 0.02 percent, respectively. The new silica crystals

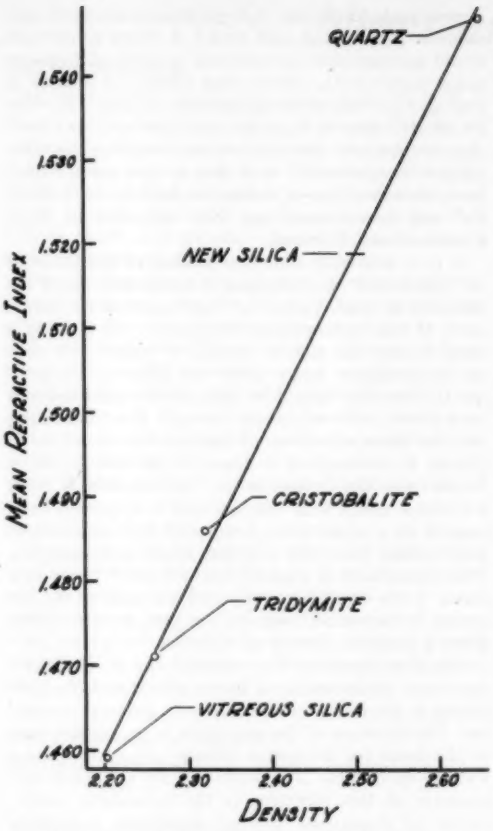

Fig. 1. Interpolation of density of new silica from plot of density versus mean refractive index of known forms of silica (off-scale plot of dense silica described by Coes (*10*) is not included).

are very stable thermally—heating at 1100°C for 37 hr showed little, if any, conversion to cristobalite. Heating for 3 hr at 1620°C changed the crystals completely to cristobalite. Conversion to the other known forms of silica in the presence of Na_2WO_4 is effected easily in the usual temperature ranges given for the stable forms.

Differential thermal analysis showed no inversions up to 1100°C. However, the indicated absence of a low-high inversion so characteristic of the other known forms of silica may have been due to the insensitivity of the apparatus or the nature of the sample and not solely to the possible nonexistence of such an inversion within the temperature range studied. The sensitivity of the instrument was such as to give only a small peak (0.27 in.) for the low-high inversion of a sample of very pure North Carolina quartz and might, in the case of a smaller heat effect, fail to register adequately. Keith and Tuttle (*5*) have noted the importance of particle size and the nature of the specimen in producing measurable thermal effects even with very sensitive apparatus. They observed that some samples of microcrystalline quartz (chert) showed measurable thermal effects only on fine grinding of the specimen to a size approaching that of the individual grains (1 to 7 μ). They also noted samples in which even this treatment did not yield a measurable thermal peak—only a change in slope gave indication of the low-high inversion. Unfortunately, the sample available for thermal analysis was microcrystalline, and it could possibly have behaved like the specimens studied by Keith and Tuttle.

Optical examination of crystals up to 50 μ in size showed them to be uniaxial negative, with $\omega = 1.522$ and $\varepsilon = 1.513$. The predominant habit is that of square platelets. Density as determined from a plot of mean refractive index (of the known forms of silica) versus density (of the respective forms) is 2.50 (Fig. 1).

Single-crystal x-ray analysis yields a primitive tetragonal unit cell with dimensions a and c of 7.46 and 8.59 A (*6*). These data taken together with the calculated value of density indicate that 12 formula weights of SiO_2 constitute the unit cell. Powder patterns using Cu K_α radiation yield the data of Table 1.

Thermal dilatation was determined on a Norelco x-ray spectrometer. A small resistance furnace served to heat the sample. Quartz was used as an internal standard (*7*); its low-high inversion being used to position a calibration curve based on readings from a thermocouple imbedded in a test sample. The results indicate that the new silica expands parallel to the c-axis up to 550°C (the temperature limit of reliable data gathered) and shrinks parallel to the a-axis up to about 250°C, at which point the true coefficient of expansion (parallel to a) passes through zero, becomes positive, and continues so up to 550°C. The calculated over-all effect on an aggregate is shown in Fig. 2. From this, it is seen that the new silica exhibits a negative mean linear expansion from 25°C over the range of temperature studied. The coefficient is of about the same order of magnitude as that of vitreous silica.

The similarity in structure between the new silica

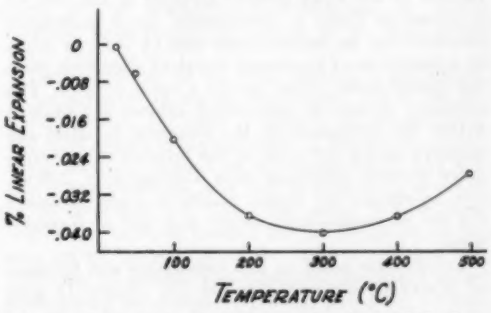

Fig. 2. Mean linear thermal expansion from 25°C of an aggregate of the new silica, calculated from expansion of unit cell parameters.

Table 1. Comparison of x-ray powder patterns of the new silica, β-spodumene, and Endell's "intermediate-I."

New silica			β-Spodumene		Intermediate-I
hkl	*d* observed	Relative intensity	*d* observed†	Relative intensity	*d* observed
100	7.46 A	VVW*			
101	5.64	½	5.74 A	0.4	
110	5.28	½			
111	4.50	2	4.56	.1	
					4.0 A (amorph)
102	3.72	7	3.86	3.5	
201	3.42	10	3.46	10.0	3.4
112	3.33	2			
210			3.30	0.4	
211	3.11	2	3.14	1.0	
103			2.83	0.3	
113	2.516	½	2.64	.3	
222	2.246	½	2.29	.7	
213	2.174	½	2.25	.4	
004	2.148	½			2.15
312	2.067	½	2.10	.6	
114	1.988	VW			
303	1.879	½			
400	1.864	1	1.875	.1	1.85
	1.667	½			
	1.636	VW			
	1.589	VW			
	1.562	½			
	1.489	½			
	1.441	VW			
	1.412	½			
	1.389	VW			
	1.366	VW			
	1.321	VW			
	1.246	VW			

* VW, very weak; VVW, extremely weak.
† Smaller *d* values of β-spodumene are not included here.

and β-spodumene, $Li_2O \cdot Al_2O_3 \cdot 4SiO_2$, is seen by comparison of the x-ray powder patterns of the two, as is shown in Table 1. Presumably, the β-spodumene structure can be derived from that of the new silica by substitution of the larger, trivalent aluminum atom for quadrivalent silicon up to a ratio of 1 : 2. The necessary amount of monovalent lithium is contained within the interstices of the structure to offset the negative charge left over by the tetrahedrally coordinated trivalent aluminum atom. Consequently, diffraction by similar *hkl* planes results in larger *d* values for the correspondingly larger unit cell of β-spodumene.

Calculations based on this assumption and the data of Karkhanavala and Hummel (*8*) (Table 1) give approximate tetragonal unit cell dimensions for β-spodumene of $a = 7.5$ A and $c = 9.0$ A. Such a unit cell would accommodate two formula weights of β-spodumene, $Li_2O \cdot Al_2O_3 \cdot 4SiO_2$. The calculated density is 2.45 g/cm³. The observed density is 2.35 (*9*). The actual structure of β-spodumene, however, may be a slightly distorted derivative of the foregoing. Another silicate, "μ-cordierite," may also be structurally similar to the new silica—a correlation between "μ-cordierite" and β-spodumene has been suggested by Karkhanavala and Hummel.

It is of interest to note here a study of the behavior of "silicic acid" as it changes to cristobalite under the influence of heat. Endell (*2*) has reported the occurrence of two "intermediate structures" and possibly a third during the careful heating of silicic acid over the temperature range 1000° to 1300°C. Unfortunately, the only obtainable data on the intermediates were a few x-ray reflections for each. It is interesting that the three reflections of Endell's "intermediate-I" (Table 1) correspond to three of the new silica; a fourth possible reflection of intermediate-I with $d = 3.72$ A and a fifth with $d = 4.50$ A may have been masked by a broad, amorphous peak that remained to some extent from the original silicic acid material. This resemblance of Endell's intermediate-I to the new silica, in the available x-ray patterns and in the sequence of formation, indicates but does not prove definitely a possible identity of the two.

The afore-described data establish the existence and conditions of formation of a new phase of silica, possessing a characteristic structure and physical properties. The structure of the new silica is unique and may be the basis for derivative silicate structures among which β-spodumene is an example. An apparent consequence of this structure is the interesting combination of directional thermal expansion properties leading to a small negative mean linear thermal expansion up to 550°C and higher.

References and Notes

* Present address, Norton Company, Worcester, Mass.
1. This preliminary paper is based on a thesis to be presented as part of the requirements for the Ph.D. degree in the School of Ceramics, Rutgers University. I acknowledge with thanks the advice and assistance of Robert B. Sosman in the preparation of the paper and the receipt of financial assistance from the research funds of the university in support of the experimental work.
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News and Notes

Soil Microbiology

The first Soil Microbiology Conference in the United States, sponsored jointly by the American Society of Agronomy, the Soil Science Society of America, and Purdue University, was held in West Lafayette, Ind., 21–24 June. A keen interest in soil microbiology was shown by more than 200 registrants who represented federal, state, and private research agencies, educational institutions, and commercial interests.

The 2½-day sessions presented 14 invitational papers dealing with the role of soil microorganisms in organic matter and nitrogen transformations in soil; with microbial contributions to the physical properties of soils, to the mineral nutrition of plants, and to plant disease control; and with the frontiers still remaining for soil microbiological research. There were two evening sessions, one of which was devoted to informal discussions of some current problems in soil microbiology, and the other to a dinner meeting at which Robert M. Salter was the guest speaker and discussed "Soil microbiology in America."

The organizing committee believes that the conference successfully accomplished its objectives, particularly in defining the place for soil microbiology in soil science and in emphasizing the desirability of teamwork among soil microbiologists and scientists in such other fields as soil chemistry, soil physics, plant physiology, phytopathology, and fertilizer usage.

LEWIS W. ERDMAN

U.S. Department of Agriculture, Beltsville, Maryland

Friends of the Pleistocene (Midwest)

On 29–30 May the fifth annual field conference of the midwest group of the Friends of the Pleistocene was held in central Minnesota. The trip was directed by H. E. Wright, Jr., of the University of Minnesota, assisted by A. F. Schneider and H. F. Arneman (Soils), and was based largely on work sponsored by the Minnesota Geological Survey, G. M. Schwartz, director. The conference was attended by about 75 geologists, soils scientists, and others from Ohio, Michigan, Illinois, Wisconsin, Iowa, Minnesota, North Dakota, Nebraska, and Colorado. A day and a half were spent in the field, and an evening meeting was arranged at Brainerd for review of the problems and for discussion of a number of controversial questions.

The principal objective of the field conference was the examination of the relationships among the several glacial drifts of Cary age. The drifts involved are readily recognized by differences in color, pebble lithology, and carbonate content, and the forms of the several ice lobes are delineated by patterns of drift distribution, drumlins, and moraines. Sequence of glaciation among the Cary ice lobes is shown by stratigraphic relationships and by drainage features.

Stops were made at various exposures along the St. Croix moraine from Minneapolis northwest for 125 mi. This moraine principally represents the terminus of ice lobes that brought brown and red till from northeastern Minnesota and the Lake Superior basin, respectively, but within it there is buff (gray where unoxidized) calcareous till with a source to the northwest in Manitoba, represented to the west of the moraine by the Wadena drumlin field. Several exposures were visited where buff till or sand is interbedded with red till or sand, in layers ¼ to 2 in thick. These are interpreted as representing deposition by or from two fluctuating ice lobes existing simultaneously in close proximity. The postulated mechanism of ice-front deposition was not accepted by all participants in the conference. However, difficulties are encountered as well by hypotheses involving only a single ice lobe, such as a mechanism whereby pure buff drift, derived far up-glacier, would be deposited from an englacial position alternately with pure red drift that had been picked up locally from the substratum.

In addition to the interbedding of different drifts visible in single exposures, there are stratigraphic relationships extending over an area 50 mi across that indicate a broad overlap zone marked by major fluctuations in the positions of the several Cary ice lobes. In general, though, it appears that the major sequence was as follows. Much of the evidence for this sequence was examined during the field conference. (i) As the ice from Manitoba retreated, ice lobes from the Lake Superior basin and from northeast Minnesota advanced side-by-side, with some mixing, as far as the center of the state, bringing red and brown drifts, respectively. These lobes overrode or truncated the Wadena drumlin field and built the prominent St. Croix moraine at their terminus, having formed their own drumlin fields behind to the east of the moraine. Continued activity of western ice is shown by the interbedding of buff drift with both the red and the brown drifts within the St. Croix moraine. (ii) Gradual but differential retreat of the eastern ice lobes permitted meltwater to form a striking series of north-south frontal drainageways within the St. Croix moraine, until finally the course of the Mississippi River was reached.

The complexity of the Cary history is epitomized by an exposure in the St. Rosa esker, within the St. Croix moraine. The esker is made of calcareous gravel and sand related to the buff drift, is overlain by a generally uniform blanket of interbedded buff and red tills a few feet thick, and then is capped by as much as 20 ft of buff till. The esker seems to have been overridden twice, to account for the formation of the two covers. At one place the esker gravel and the overlying till blanket were intensively deformed by ice push during the second overriding, producing vertical isoclinal folds 15 ft across. The main esker form, however, seems not to have been greatly modified by this action.

An objective of the second day of the field conference was an examination of exposures of red clayey till that is correlated with the Valders drift of northeastern Wisconsin. At the exposures examined, the Valders till, near the western limit of its development, is interbedded with buff calcareous sand and silt that shows Mankato drift from the west. As with the Cary drifts, these exposures are interpreted as representing simultaneous existence of eastern and western ice lobes and imply the correlation of the Valders with Mankato.

One general impression seems to have been successfully imparted during the course of the conference—the complexity of the Cary glaciation in central Minnesota. Many relationships will certainly be clarified by further fieldwork, but the complexity here displayed is in part a result of the relative ease of differentiation of the drifts of the several ice lobes involved. Perhaps in other areas such complexities are simply not even suggested because drift lithologies of adjacent ice lobes are not sufficiently diverse. The hypothetical mechanisms for the apparent intimate interbedding of drifts might be confirmed by examination of the deposits of modern ice sheets and piedmont glaciers composed of separate ice lobes or tongues. Current glaciologic investigations of Greenland and other ice sheets and of piedmont glaciers will give an increasing number of glacial geologists the opportunity to combine observations on the stratigraphy of Pleistocene drifts with observations on active drift deposition by modern glaciers and may indicate the correct hypothesis for the genesis of the interbedded drifts under consideration during the field trip.

H. E. WRIGHT, JR.

University of Minnesota

Science News

A **"Statement of Views on a Balanced Security Program"** was prepared recently by the Los Alamos branch of the Federation of American Scientists and submitted to Lewis L. Strauss of the Atomic Energy Commission. Excerpts from the statement follow:

(i) . . . It is only secrecy, the negative contribution, which is seriously considered in our security program. We must recognize the need in any balanced view of the problem for considering positive security. Potential contributors to positive security must not be eliminated except for the most compelling reasons of negative security. . . .

(ii) We believe that the general basis for clearance should be: "Clear this man *unless* you have after careful investigation determined that there exists reasonable doubt as to his ability to meet the necessary requirements." Such a positive approach is in the highest democratic tradition. . . .

(iii) . . . An individual merits the withholding of security clearance only when he is demonstrably disloyal to our Constitution, clearly indiscreet in his protection of classified matters, dishonest, or susceptible to coercion to treason.

(iv) . . . guilt by association is not a sound guiding principle in the security system of a brave nation. When an individual associates with a large number of reputedly disloyal people, it may be possible to advance the charge of flagrant indiscretion or even disloyalty, but when a few such associations can outweigh all other evidence of discretion and loyalty, the security system is in danger of becoming monstrous.

(v) . . . each man may bring to any discussion not only those ideas and conclusions which fall within his technical competence, but also such moral considerations as he considers pertinent, each man according to his own conscience.

(vi) . . . free citizens, including advisors to government, have the unquestioned right of dissent, including the right of dissent after an administrative decision has been taken.

Fluoridation of drinking water started in the 1000th town, Osawatomie, Kan., on 12 Aug. Fluoridated water and its tooth benefits are now available to some 18 million persons, according to a recent estimate by the American Dental Association.

In the 24 July issue of the *Journal of the American Medical Association*, G. W. Anderson and J. L. Rondeau discuss statistical findings of an epidemiologic **survey of 2669 cases of poliomyelitis** during the 1946 outbreak in Minnesota. These observers found that persons with bulbar poliomyelitis, as evinced by such symptoms as difficulty in swallowing and breathing, were more likely to have had their tonsils removed than those with spinal or nonparalytic forms of the disease. The accumulated data showed that bulbar involvement occurred in more than a third of the patients whose tonsils were not present, whereas less than a tenth of the patients who had not had tonsillectomies showed bulbar response. Absence of the tonsils increased the risk of bulbar involvement about fourfold. The authors felt that the higher proportion of bulbar poliomyelitis seen in older persons is due primarily to the absence of the tonsils rather than to age *per se*. They found no evidence of the effect of tonsillectomy in altering susceptibility to clinically recognizable poliomyelitis, and their study was concerned only with the likelihood of a bulbar involvement if clinically recognizable poliomyelitis developed. —E. M. L.

Arnold H. Sparrow and Eric Christensen, biologists at the Atomic Energy Commission's Brookhaven National Laboratory, reported in *Nucleonics* for August that the normal **storage life of potatoes** can be prolonged by exposure to nuclear radiation.

At the recent meetings of the American Branch of the International League Against Epilepsy and the American Academy of Neurology at Washington, D.C., Roscoe L. Barrow, dean of the Cincinnati Law School, and Howard D. Fabing, epileptologist, reported on a survey of **laws dealing with epilepsy.** They revealed that 19 states prohibit marriage of epileptics, that 15 states are required by law to place epileptics in institutions which also house persons with mental retardation and psychoses, that 18 states insist upon the

sterilization of those afflicted, and that 47 states, including New York, deny epilepties driving licenses even when they are under total medical control.

The participants in the meeting took the unequivocal stand that "epilepsy should be no bar to marriage or the pursuit of normal living." Edward D. Schwade disclosed that in Wisconsin—the only state in which epileptics are regularly permitted to drive, upon approval of a special Commission—there have been no accidents that can be ascribed to a seizure.

In a paper on epilepsy and accident rates, Dr. Sands, executive director of the Epilepsy Association of New York, pointed out that the great majority of accidents occurring to persons with epilepsy do not occur during or because of seizures, and are of the kind that can happen to anybody.

The American Council of Learned Societies reports that the Soviets are producing **dictionaries in 80 languages.** An ACLS statement adds: "All 80 cost less than one round-trip bomber. We are making dictionaries too—three of them so far, and we'll start the fourth when we can find the money for it."

An editorial in *Chemical and Engineering News* of 2 Aug. deplores Defense Department reticence on the subject of **biological warfare,** saying that it "does not confuse any potential enemy" but does hamper the development of sound Civil Defense plans. The Army Chemical Corps since Nov. 1942 has conducted research on both defensive and offensive aspects of biological warfare. With federal budget figures and construction contracts available to anyone interested, a fair idea of the extent of U.S. activities in the field may be obtained. Failure of the Defense Department to set the facts straight, however, has left the American public uninformed and has led to exaggerated claims and wild flights of fancy in popular articles.

The **first transoceanic statistical information** to be radioed directly from one punched card to another was sent recently by the U.S. Air Force from Port Lyautey, near Casablanca, Morocco, across 3000 mi to Washington, D.C. During a 1-wk experimental period, information was sent between these two points, in both directions, at the rate of approximately 1000 characters per minute by an IBM data transceiver.

The **altitude record** for single-stage rockets was set on 24 May when the Naval Research Laboratory's Viking 11 reached a height of 158 mi above the White Sands Proving Grounds at Las Cruces, N. Mex. The previous record was set on 6 May, when the Viking 10 tied the old single-stage altitude record of 136 mi.

The Viking 11, measuring 45 ft and weighing 7½ tons, topped that mark by 22 mi; its maximum speed was 4300 mi/hr. The rocket's warhead—carrying almost 1000 lbs of electronic instruments to relay and record information about the outer atmosphere—was recovered intact 24 mi northwest of the launching site. The warhead is blasted away from the body of the rocket at optimum altitude and then falls free. Its bulky design serves as a brake in the lower atmosphere. Most of the information obtained from the rocket was transmitted to the ground during the flight by means of a radio telemetering system designed by NRL.

Archeologists have discovered the remains of an entire **Arctic village,** last occupied more than 1000 yr ago, on the Melville Peninsula in Canada's Northwest Territories. It is the largest site yet found in the eastern Arctic. Test excavations already have revealed the presence of more than 100 houses, in addition to graves, implements, and other finds, that identify the site as belonging exclusively to the Dorset cultural era. The finds include organic remnants that contain abundant carbon, thus making possible a carbon-14 dating. The excavations are being carried out by a joint University of Pennsylvania–National Museum of Denmark team headed by Jorgen Meldgaard, assisted by Richard Emerick of the university museum.

Studies are expected to shed new light upon this little-known era and its relationship to other early Arctic cultures. The first identification of the Dorset culture as a separate and distinct culture, older than the whale-hunting Thule Eskimos of the eastern Arctic, was made in 1925 by Diamond Jenness of the Canadian National Museum. Since that time artifacts of Dorset origin have been found in the vast area from Newfoundland to northern Greenland, but they have nearly always occurred in deposits containing relics of other cultures. This has made it difficult to determine whether the Dorset culture was contemporaneous with other Arctic cultures and the extent to which it influenced or was influenced by other cultural patterns.

A yardstick to measure the **availability and volume of mental health clinic services** is an apt description of the new reporting procedure set up by the National Institute of Mental Health in close cooperation with the mental health authorities of the states. Initiated on a nationwide basis on 1 July, it marks the first comprehensive attempt to use uniform statistical reporting to gather data concerning psychiatric outpatient services. Briefly, the plan calls for each state's mental health agency to distribute a reporting form to clinics. After completion by the clinics, the forms will be returned through the state agencies to the Public Health Service Regional Offices and then to NIMH's Biometrics Branch, where the data will be tabulated and analyzed and summary reports published. The project, which was 2 yr in the planning and preoperational stage, is directed by Morton Kramer, chief of NIMH's Biometrics Branch, assisted by Anita Bahn, chief, Outpatient Reports and Records Unit.

The U.S. Atomic Energy Commission has revised its **radioisotope distribution regulations** to cover radioisotopes produced in any publicly owned or privately owned nuclear reactor located within the United States, its territories, or possessions. The revised regu-

lations subject radioisotopes produced in publicly or privately owned reactors to the same radiological safety controls as those produced in or distributed by AEC facilities.

A **new comet** has been found in the familiar constellation of Ursa Minor by Walter Baade of Mount Wilson and Palomar Observatories. It is of 15th magnitude, too faint to be seen without a very large telescope.

Albert E. Caswell, professor emeritus and former head of the department of physics at the University of Oregon, died on 18 June in Eugene, Ore., at the age of 70. He was born in Winnipeg, Manitoba, and received his doctor's degree from Stanford University in 1911. After 2 yr at Purdue University he went to the University of Oregon. He was appointed chairman of the department in 1934 and served in that capacity until 1949. During World War II he was a member of the staff of the Radiation Laboratory at MIT. Prof. Caswell was the author of a widely used textbook in general physics.

Scientists in the News

Alfred B. Babcock, Jr., one-time assistant branch chief of the New York Operations Office, U.S. Atomic Energy Commission, has been named chief project engineer of the Borden Co.'s chemical division.

Richard H. Baker, former electronic computing and control systems consultant, has joined the staff of Stanford Research Institute as a systems engineer. He will work in the recently expanded electronic data processing unit—a section of S.R.I.'s division of industrial economics research.

Harrison Brown, professor of geochemistry at the California Institute of Technology, is leaving this month on a 6-mo trip to participate first in the meeting of the International Geophysical Union, then to spend about 6 wk visiting geochemical laboratories in Switzerland, France, Belgium, and England, and finally to conduct a 3-mo study of mineral resources in India. This survey, sponsored by the Rockefeller Foundation, will be made with the cooperation of the Indian government.

Dana L. Farnsworth, medical director at the Massachusetts Institute of Technology, has been made Henry K. Oliver professor of hygiene, to direct all medical care in Harvard University, effective 1 Sept. As M.I.T.'s first full-time medical director, Dr. Farnsworth established a student insurance plan and expanded the medical, psychiatric, dental, x-ray, and occupational medicine services.

Dr. Farnsworth succeeds **Arlie Vernon Bock,** who has been the Oliver professor since 1935. At Harvard's commencement exercises in June Dr. Bock received the honorary degree of doctor of science with the citation: "A grateful patient honors her physician of three decades, whose human sympathy has been devoted to both the sick and the well."

Saul Krugman has been appointed associate professor of pediatrics at New York University–Bellevue Medical Center's College of Medicine. He is currently engaged in work on infectious diseases with particular emphasis on German measles.

Edwin M. Lerner, II, previously pathologist at the Biological Laboratory, Camp Detrick, Frederick, Md., joined the staff of the Laboratory of Pathology and Histochemistry, National Institutes of Health, Bethesda, Md., on 1 Aug.

C. Gordon Little was made assistant director of the Geophysical Institute of the University of Alaska on 1 July.

For his 25 yr of distinguished service to the University of Minnesota, **Irvine McQuarrie,** head of the department of pediatrics, will be honored at a pediatrics grand reunion 23–25 Sept. at the university. Colleagues and students of Dr. McQuarrie have planned the event in conjunction with the annual Northwestern Pediatric Society meeting. Lectures will be given at the meeting by 22 academic leaders in pediatrics, most of whom received their training under Dr. McQuarrie.

As an additional tribute, a McQuarrie Pediatrics Fund has been established with a goal of $50,000. The annual income will be used for such purposes as to support a lectureship in pediatrics, to provide travel funds for pediatrics staff members, or to provide fellowships in unusual circumstances.

Dr. McQuarrie, a graduate of the University of Utah who received his Ph.D. degree from the University of California and his M.D. degree from The Johns Hopkins University, joined the University of Minnesota staff in 1929. Before that he had served on staffs of the University of California, Henry Ford Hospital, Yale University, and the University of Rochester. In addition to his duties at the university during the past 25 yr, he was visiting professor of pediatrics at Peking Union Medical College in China and served on the China Medical Board of the Rockefeller Foundation. Lecture assignments have taken him to many parts of the world.

A. H. Moseman, crop research director for the U.S. Department of Agriculture, was the principal speaker on 18 Aug. at the annual visiting day of the Rice Branch Experiment Station, Stuttgart, Ark.

Howard Potter has been named acting dean of the State University of New York College of Medicine in Brooklyn. Dr. Potter, who is professor and chairman of the college's department of psychiatry and director of psychiatric services at Kings County Hospital, will assume his new duties on 1 Sept. This appointment will permit Jean A. Curran, dean of the college for 17 yr, to assume his new post as associate executive dean for medical education of the State University.

Meetings

The tentative program has been announced for the **5th Alaska Science Conference** of the AAAS Alaska Division, which will take place in Anchorage, 7–10 Sept. There will be groups of papers on agriculture and forestry, engineering, biological sciences, medicine and public health, social sciences, and physical sciences. There will also be several symposiums on such subjects as "Resource planning in northern Alaska."

Several hundred foresters, industry representatives, civil servants, and private citizens interested in conservation of the nation's natural resources will convene 6–9 Sept. in Portland, Ore., for the 79th annual meeting of the **American Forestry Association.**

More than 500 American and Canadian physiologists will attend the 6th annual fall meeting of the **American Physiological Society,** 8–10 Sept., at the University of Wisconsin, where 272 papers will be presented. W. B. Youmans, chairman of the Wisconsin department of physiology, is chairman of the committee on local arrangements. Herbert S. Gasser, a Nobel prize winner and until recently director of the Rockefeller Institute for Medical Research, will chair one of the sessions. Another session chairman will be Carl J. Wiggers, editor of *Circulation Research* and formerly head of the department of physiology at Western Reserve University. Dr. Wiggers is known as the "Dean of Physiology."

Three other groups of physiologists will meet at the university on the 2 days prior to the APS gathering. A refresher course in the physiology of respiration will be conducted by J .R. Comroe, professor of physiology and pharmacology at the University of Pennsylvania Graduate School of Medicine, and Herman Rahn, associate professor of physiology at the University of Rochester School of Medicine and Dentistry. Some 90 physicians are expected to participate.

Also, approximately 100 physiologists will attend a 2-day session to review a long-range survey of the physiological sciences sponsored by the American Physiological Society. The survey, begun 2 yr ago, is a comprehensive study of physiology as a profession.

While these two groups are on the campus, members of the Physiology Study Section, U.S. Public Health Service, will meet to consider applications for grants-in-aid for research projects.

The 8th annual meeting of the **American Society for the Study of Arteriosclerosis** is to be held in Chicago 31 Oct.–1 Nov. The full program and 63 abstracts of papers will appear in the October issue of *Circulation.*

This year the **American Society of Zoologists** will hold its annual meeting at the University of North Carolina 28–30 Dec. This is the first time in 19 yr that the society has not met in conjunction with either the AAAS or the American Institute of Biological Sciences.

Abstracts for papers should be sent to the secretary, Rudolf T. Kempton, Vassar College, Poughkeepsie, N.Y. Prior to 7 Sept., time will be saved by addressing mail to Dr. Kempton at the Marine Biological Laboratory, Woods Hole, Mass. All abstracts must be submitted *on or before 19 Sept. 1954.* If no abstract accompanies a title, or if title and abstract are received later than 19 Sept., a paper can be placed on the program only by vote of the society at Chapel Hill.

Professors of **chemistry and chemical engineering** from more than 30 leading American colleges and universities will be guests of the General Electric Co. in Schenectady, N.Y., at a special conference scheduled for 8–11 Sept. The purpose is to acquaint teachers of chemistry and chemical engineering with work under way in various G.E. departments.

The resurgence of the foreign chemical industry will be discussed at a meeting of the **Commercial Chemical Development Association** in Bedford, Pa., 7–8 Oct., under the chairmanship of Frank Waldo. Research carried on abroad is now resulting in numerous new products and processes and is bringing the foreign chemical industry back to its previous world-wide prominence. Six papers analyzing specific phases of international commercial development will be presented on the first day of the meeting. The second day will be devoted to a panel discussion of case studies.

Education

The Council on Dental Education of the American Dental Association has announced that the first series of **dental aptitude tests** for applicants to the 1955 freshman dental school classes will be given 1–2 Oct. College students interested in taking the tests during this series *must submit their applications to the association by 17 Sept.*

Astronomers and electrical engineers at the University of Pennsylvania have joined forces in a program to pioneer new **electronic methods of observing the stars.** To foster the development of new observational aids, the university has established a working partnership between its department of astronomy and its Moore School of Electrical Engineering.

The **first American textbook in written Hindi** is being prepared at Cornell by John Gumperz of the university's modern language division. The new book, *An Introduction to the Hindi Alphabet and Elementary Hindi Reader,* is intended as a companion volume to *Spoken Hindi,* prepared for the U.S. Armed Forces and published by Henry Holt and Co. After Dr. Gumperz completes the book, he will go to India for a year's research on the village dialects of Hindi and how they are being changed by city speech; he will work in India under a grant from the Ford Foundation's Board of Overseas Training and in cooperation with Cornell's anthropological field station.

Hindi, formerly Hindustani, will replace English

as the official language of India in 1962. Hindi was brought to India by Aryan invaders in the 7th and 8th centuries A.D. It or its dialects is now spoken by three-eighths of the population. Dravidian languages, derived from the speech of India's original inhabitants, are spoken only in the south.

Ground was broken for the new $1,350,000 building of the **Georgetown University School of Nursing** on 15 Aug. The building will be the first to be erected under the Greater Georgetown Fund, the university's 10-yr $14 million development program.

"Medical Issues in Legal Cases," a 15-wk course designed especially for physicians, will be offered this fall by the new Law-Medicine Center at Western Reserve University. Course material will concern personal injury cases involving legal rights.

Fourteen outstanding medical specialists will take part in a series of evening discussions on **medicine for the layman,** starting 7 Oct., at Columbia University.

A separate department of psychiatry has been organized at **Stanford School of Medicine,** San Francisco. George S. Johnson, professor of medicine since 1933, has been appointed executive head of the new department. Psychiatry had previously been included in the department of medicine.

Available Fellowships and Awards

The **American Cancer Society** has announced a number of clinical fellowships that offer graduates in medicine opportunities for postgraduate training emphasizing diagnosis and treatment of cancer. Since fellowships are awarded to institutions only upon application by deans, executive officers, or department heads, interested persons should consult the appropriate authority in the institution of their choice. Applications for 1955–56 *must be submitted prior to 15 Sept.* Further information may be obtained from the American Cancer Society. Professional Education Section, 47 Beaver St., New York 4.

The **Arthritis and Rheumatism Foundation** is offering the following research fellowships in the basic sciences related to arthritis:

Predoctoral fellowships, $1500 to $3000 per annum, depending on the family responsibilities of the fellow, tenable for 1 yr with prospect of renewal.

Postdoctoral fellowships, $4000 to $6000 per annum, depending on family responsibilities, tenable for 1 yr with prospect of renewal.

Senior fellowships for more experienced investigators, $6000 to $7500 per annum, are tenable for 5 yr.

The deadline for applications is 15 Oct. For information, address the Medical Director, The Arthritis and Rheumatism Foundation, 23 W. 45 St., New York 36.

The **John and Mary R. Markle Foundation,** 511 Fifth Ave., New York, announces that it will continue for the eighth year its program of 5-yr grants for Scholars in Medical Science. The purpose is to offer academic security and financial help to medical school faculty members at the start of their careers in academic medicine. Since the initiation of the program, in 1948, a total of $3,950,000 has been granted toward the support of 136 doctors in 59 medical schools. In 1954, 25 men were chosen, the largest number for any year.

The 5-yr grants are made at the rate of $6000 annually to the medical school where the Scholar will teach and conduct research. Each medical school is invited to nominate one candidate *on or before 1 Dec.* A publication outlining the plan will be sent on request.

To increase the number of well-trained teachers in the field of preventive medicine, the **National Foundation for Infantile Paralysis** is now offering a limited number of fellowships to physicians interested in study and research in the teaching of preventive medicine. The program of study may be undertaken at an approved school of public health or in a department of preventive medicine of an approved medical school. Fellowships will be awarded for one or more years, with stipends ranging from $4500 to $7000 a year, depending upon marital status and number of dependents.

The fellowships will be given only to graduate physicians in good health who are U.S. citizens or applicants for citizenship, who have completed at least 1 yr of internship in an approved hospital, and who have had not less than 2 yr of additional training and experience, including some teaching responsibility, in one of the specialties relating to preventive medicine. Each recipient must have the intention of teaching preventive medicine in the United States or its territories after completing his studies. Applications are accepted any time during the year. For details address the National Foundation for Infantile Paralysis, Division of Professional Education, 120 Broadway, New York 5.

Grants and Fellowships Awarded

An expanded program in radio astronomy will be launched by Australian scientists, aided by a $250,000 **Carnegie Corp. grant.** The award will be administered by the Commonwealth Scientific and Industrial Organization in Australia. The largest single appropriation to an Australian agency made by the Carnegie Corp. in 25 yr, it will provide part of the costs of constructing a giant parabolic reflector or receiving antenna, 250 ft in diameter and some 60 ft deep. About 3 yr will be needed to build and mount the reflector.

It has been designed by the Radiophysics Laboratory of the Commonwealth Scientific and Industrial Research Organization under the direction of E. G. Bowen, physicist, and his chief assistant, J. L. Pawsey, at the University of Sidney. Another reflector of

comparable size is now under construction at the University of Manchester in England from government and Nuffield Foundation funds.

The **Dental Branch, Biological Sciences Division of the Office of Naval Research,** has awarded the following research contracts to universities and nonprofit research institutions for periods of one to three years.

University of Alabama, Ward Pigman. Development of an artificial mouth for *in vitro* studies of dental caries.

Tufts College Dental School, Vincent F. Lisanti. Salivary enzymes related to oral disease.

Tufts College Medical School, Zareh Hadidian. Specific anti-hyaluronidases in serum.

University of Southern California, Lucien A. Bavetta. Amino acid deficiencies in bone and tooth metabolism.

The Jewish Hospital of Brooklyn, Albert E. Sobel. Mechanism of calcification and the caries problem.

University of Illinois, Isaac Schour and Maury Massler. Clinical and experimental investigation of pulpotomy in permanent teeth.

University of Southern California, Lucien A. Bavetta. Effects of tryptophane deficiency on the teeth and periodontium.

University of Minnesota, David F. Mitchell. Research in periodontal disease.

Georgetown University, Walter C. Hess. Proteins and mucopolysaccharides of teeth.

Melvin L. Winer, research pathologist at the Cancer Institute at Miami, has been awarded a research fellowship in cytology by the **Eugene L. Garey Foundation, Inc.,** of New York.

The American Medical Association's award for scientific exhibits, the **Hektoen gold medal,** went to the Veterans Administration during the recent AMA meeting in San Francisco. The exhibit depicted the scope of work being done at Houston, Tex., in connection with the diagnosis and surgical treatment of the diseased aorta and its main branches. The Houston project is under the direction of Michael E. DeBakey, professor of surgery at Baylor University and a consultant at the VA hospital. Assisting Dr. DeBakey are Oscar Creech, chief surgeon, and Denton A. Cooley, attending surgeon of the VA hospital staff. Two other VA exhibits that received honorable mention were "Diseases of the chest section" and the ophthalmology display "Multiple pattern of visual field examination."

The **Public Health Service** has announced approval of 1442 grants for assistance of medical research, aggregating $14,685,671. Less than one-third of the awards are for new projects. The remaining grants are for investigations already under way. As in the past, a maximum of 8 percent of a grant may be used to defray overhead expenses. A proposal to raise this allowance to 15 percent is still under consideration. Awards will be administered by the following components of the National Institutes of Health.

Arthritis and Metabolic Diseases: 66 new grants, $629,271; 146 continuations, $1,375,263.

Neurological Diseases and Blindness: 55 new, $471,178; 140 continuations, $1,327,089.

Cancer: 92 new, $981,074; 195 continuations, $2,182,395.

Dental research: 10 new, $73,292; 13 continuations, $113,873.

Microbiological: 77 new, $610,620; 64 continuations, $704,863.

Heart: 81 new, $912,938; 213 continuations, $2,283,370.

Mental Health: 25 new, $373,178; 42 continuations, $569,393.

For noncategorized research, administered by the NIH Division of Research Grants: 53 new, $516,522; 170 continuations, $1,561,352.

In the Laboratories

A new **a.c. network calculator** has been put into service by the Franklin Institute in cooperation with seven major power companies in Pennsylvania, New Jersey, and Delaware. The utilities will use this $400,000 computing device to help solve the many complex problems involved in maintaining and expanding their power systems.

American Rocket, a new company near Wyandotte, Mich., has been formed for consultation, research, development, production, and testing of rocket and jet devices. Present operations deal primarily with research aspects of both liquid and solid rocket propellants, but consideration will be given to control and guidance of rockets, as well as aeronautical, automotive, chemical, and industrial applications. Office, laboratories, pilot plant, test facility, and a machine shop are in operation. Alfred J. Zaehringer heads the new firm.

Three **amino acids tagged with carbon 14** are newly available from BIO-RAD Laboratories, Berkeley, Calif., in 1-mc standard packages. They are *dl*-norleucine 2-Cl^{14}, *dl*-norvaline 1-C^{14}, and *dl*-norvaline 2-C^{14}. The latter two compounds, having specific labels in two different positions, are expected to be particularly useful in studies involving the mechanisms of amino-acid metabolism.

Parke, Davis & Company has announced a new product, blastomycin, for use in the skin-test diagnosis of **blastomycosis,** also known as Gilchrist's disease, a fungus infection that may occur in any part of the body, but particularly attacks the skin, lungs, and bones, resulting in lesions. The new product is the sterile filtrate from a culture of *blastomyces dermatitidis* and is standardized according to the National Institutes of Health regulations.

Marking its fifth expansion in eight years, **Blue M Electric Co.,** manufacturers of electric ovens, furnaces, and related temperature control equipment for laboratories, pilot plants, and production, is erecting a 22,000^2 ft, 1-story building on 2 acres in Blue Island, Ill. Occupancy will begin 15 Sept.

Glyceric acid is now available as a reagent with a minimum assay of 95 percent, instead of the former 30 percent, from the Fisher Scientific Co., Pittsburgh.

Miscellaneous

A 346-page book containing 3512 **abstracts of articles and books on corrosion** is now available from the National Association of Corrosion Engineers, 1061 M & M Building, Houston 2. The articles, from more than 500 periodicals published all over the world in 1948–49, were abstracted by some 30 agencies that authorize NACE to use their abstracts. The two previous volumes covered literature published in 1945 and 1946–47.

The Scientific Motion Picture and Photographic Products Division of the Department of Commerce is sponsoring an **exhibit of American scientific instruments** in the main lobby of the Department of Commerce Building from 27 Sept. to 9 Oct. Members of the Scientific Apparatus Makers Association are cooperating with the Department of Commerce to make this first public showing possible.

A new periodical, **Journal of Nuclear Energy,** of interest to nuclear scientists and engineers, has been announced by the Pergamon Press, Ltd., London. It will be edited by J. V. Dunworth of the Atomic Research Establishment at Harwell, with the assistance of J. Gueron of the French Atomic Energy Commission, Paris, and G. Randers of the Joint Establishment for Nuclear Energy Research, Oslo, Norway. Contents of the Journal will be restricted mainly to papers describing original work, but review articles will be included from time to time. It is hoped to include book reviews and conference reports. Papers will be accepted in English, French, and German; each paper will be preceded by an abstract in English.

An exhibit of **radio-controlled pilotless aircraft,** sponsored by the George Getz Corp., has been installed at Chicago's Museum of Science and Industry. It consists of a variety of target planes developed for use in gunnery practice to simulate attacking enemy aircraft and guided missiles. Through radio control, these target "drones" can imitate high- and low-level bombing, evasive action, dive bombing, various aircraft flight patterns, and radar tracking. They may be controlled from the ground or from another aircraft, launched from the ground, a ship, or another aircraft, and this control may be switched from ground to air or vice versa.

Necrology

John Alexander, 63, author, medical lecturer, and chief of thoracic surgery at the University of Michigan, Ann Arbor, Mich., 16 July; **Saul B. Arenson,** 58, professor emeritus of chemistry at the University of Cincinnati, Cincinnati, Ohio, 11 June; **Katharine Blunt,** 78, chemist, author, and president emeritus of Connecticut College, New London, Conn., 29 July; **Jacques E. Brandenberger,** 81, dye chemist and inventor of cellophane, Zurich, Switzerland, 13 July; **Cornelius G. Brennecke,** 48, nuclear physicist and head of the department of electrical engineering at North Carolina State College, Raleigh, N.C., 2 Aug.; **Morris Cohen,** 51, author and chairman of the department of endodontia at New York University College of Dentistry, New York, N.Y., 24 July; **Ferry B. Colton,** 51, author and assistant editor of the *National Geographic,* Washington, D.C., 10 Aug.; **John J. Costa,** 61, author, civil engineer, and dean of the lay faculty of Manhattan College, New York, N.Y., 14 July; **Samuel J. Crumbine,** 91, author, former general executive of the American Child Health Association and dean of the School of Medicine at Kansas University, Lawrence, Kans., 12 July.

Marion F. Dondale, past president of the Medical Library Association and associate professor of Medical literature at Albany Medical College, Albany, N.Y., 28 June; **David Fairchild,** 85, author, horticulturist, and director of the office of plant introduction, U.S. Agriculture Department, Miami, Fla., 6 Aug.; **Donald T. Fraser,** 65, immunologist and associate director of the Connaught Medical Research Laboratories at the University of Toronto, Toronto, Canada, 20 July; **William O. Hotchkiss,** 76, mining engineer, geologist, and emeritus president of Rensselaer Polytechnic Institute, Troy, N.Y., 20 June; **John C. Hubbard,** 75, pioneer in the field of ultrasonics and research professor of physics at Catholic University, Washington, D.C., 2 Aug.; **Harold L. Hunt,** 72, author, editor, and former assistant professor of surgery at Columbia University, New York N.Y., 16 July; **Walter S. Hunter,** 63, author, associate editor of the *American Journal of Psychology,* and chairman of the department of psychology at Brown University, Providence, R.I., 3 Aug.; **Jacob M. Johlin,** 70, professor emeritus of biochemistry at Vanderbilt University Medical School, Nashville, Tenn., 21 July.

L. J. Moorman, 79, author, editor, tuberculosis authority, and former dean of the University of Oklahoma Medical School, Oklahoma City, Okla., 2 Aug.; **Theophile Moreux,** 87, author, astronomer, professor of mathematics, and director of the observatory at Bourges, France, 13 July; **Henry A. Rafsky,** 64, author, research gastroenterologist, and chief of the gastroenterological clinic at Lenox Hill Hospital, New York, N.Y., 31 July; **George H. Schuler,** 59, author and director of the technical laboratory, dyes and chemical division, E. I. du Pont de Nemours & Co., Deepwater, N.J., 13 July; **James S. Simmons,** 64, author, retired chief of Army preventive medicine service, and dean of the Harvard School of Public Health, Boston, Mass., 31 July; **John A. Stalfort,** 66, engineer and president of the Consolidated Engineering Co., Baltimore, Md., 14 July; **Nathan B. Van Etten,** 88, medical educator and former president of the American Medical Association, New York, N.Y., 23 July; **Bert C. Williams,** 45, professor of biology at the University of Alabama, University, Ala., 6 July; **Albert F. Zahm,** 92, pioneer in aviation, inventor, former chief of the division of aeronautics at the Library of Congress, and former professor of mathematics and mechanics at the University of Notre Dame, South Bend, Ind., 23 July.

Book Reviews

Infrared Absorption Spectra of Steroids. An Atlas. Konrad Dobriner, E. R. Katzenellenbogen, and R. Norman Jones. Interscience, New York–London, 1953. xlv + 308 pp. Illus. $11.50.

During the last decade, infrared absorption spectroscopy has been increasingly used to identify steroids, and infrared spectrophotometers have become routine instruments in many laboratories concerned with the study of steroids.

The infrared study of steroids was largely pioneered by two of the authors of this volume, the late Konrad Dobriner at the Sloane-Kettering Institute for Cancer Research in New York and R. Norman Jones at the National Research Council of Canada in Ottawa. By combining infrared spectroscopy with absorption chromatography, they were able to develop an elegant procedure for identifying and quantitatively determining the many urinary steroids excreted by patients in a variety of physiological and pathological states. During this investigation, the infrared spectra of more than a thousand steroids were recorded, and a series of spectral absorption characteristics were identified. These characteristics may be used to identify oxygen-containing functional groups, to locate certain unsaturated linkages, and to establish the stereochemical configurations at certain positions. Moreover, the infrared spectrum of a steroid is unique, and if the compound under study has been prepared previously, its identity can be established by comparing its spectrum with that of an authentic sample.

Dobriner and Jones have published many valuable tables containing correlations of spectral absorption frequencies with functional groups in steroids, but until the publication of this book spectroscopists had been handicapped by the lack of a set of reliable steroid reference spectra. This volume contains a collection of nearly 300 spectra and goes a long way toward overcoming the deficiency. Most of the spectra are of steroid hormones and of their metabolites and derivatives, but representative curves for steroid alcohols, bile acid esters, steroid sapogenins, cardiac aglycones, and steroid alkaloids are included.

The spectra are preceded by a short introduction, in which correlations of spectral absorption frequencies with structure are briefly discussed. This is followed by a bibliography that lists the principal publications on the infrared spectra of steroids. It is unfortunate that the introduction was not expanded to include in a convenient form much of the information contained in the original papers listed in the bibliography. Perhaps we may hope that in a future publication this defect will be remedied.

The spectra were obtained for solutions in carbon disulfide and in either carbon tetrachloride or chloroform and were recorded on a modern double-beam spectrophotometer as plots of percentage absorption against wave number; they are generally complete from 650 to 1800 cm^{-1}, but a few representative spectra covering the region 2700 to 3700 cm^{-1}, are given. Each spectrum occupies a full page, and the standard of reproduction is unusually high. I had no difficulty in establishing the identity of some of my spectra with certain of those included in this book. The structural and empirical formula of each compound and the concentration, solvent, cell length, and prism used in each spectral region are recorded. On the other hand, no physical data that might indicate the purity of the samples examined, such as melting points and optical rotations, are listed.

This book is essential to all those using infrared spectroscopy in the field of steroid chemistry. The method of reproducing the spectra should serve as a model for future compilations of infrared spectra.

JAMES E. PAGE

Glaxo Laboratories, Greenford, Middlesex, England

The Collected Papers of Stephen P. Timoshenko. McGraw-Hill, New York–London, 1953. xxv + 642 pp. Illus. $15.

The Collected Papers of Stephen P. Timoshenko are presented in four languages—German, French, English, and the universal language of mathematics. As a language, mathematics is subject to the same criterions of style as any other. A mathematical paper may be clear or abstruse, concise or prolix, elegant or uncouth. Every one of these papers is a masterpiece of clarity and elegance; as for brevity, Timoshenko strikes exactly the right balance, at least for engineers, who are seldom profound mathematicians. He never labors the obvious, but on the other hand, he never jumps a great chasm from one equation to another with the cliché "from this we readily derive . . . ," when the reader cannot make the derivation readily, if at all.

Eight of these papers are in German, written during the period 1910–24, two are in French, published in 1913 and 1914, and the remaining 25, the first of which appeared in 1921 and the latest in 1947, are in English. Twenty-three papers written in Russian, between 1905 and 1917, are listed by translated title only; much of the material in these is said to have been translated later into one of the other languages. Publication of the original Russian papers would have been a formidable editorial task, but it is regrettable that they could not have been included or, at least, some indication given as to where their content may now be found. There is substantially no repetition in Timoshenko's works, and nothing he wrote is unimportant.

Although the French papers are only two in number, they occupy a substantial portion of the book. One of them is the famous "Sur la stabilité des systèmes élastiques," 133 pages in length, which ap-

peared in 1913 and did so much to correct previously accepted bases for design of bridges and other steel structures. Both French papers are translations, by others, from material that Timoshenko had prepared in Russian. The German and English papers are his own expression, but it is evident that in every instance he was wise enough to accept competent editorial assistance in these acquired languages. Not a single paper betrays any of the mannerisms, such as omission of articles, characteristic of most technical papers written by the Russian-born.

D. H. Young's brief biographic sketch of the author is probably the most nearly complete story of Timoshenko's career that has been published. Born in the Ukraine in 1878, the son of a surveyor, he was educated as a railway engineer. The years before World War I he spent chiefly as a teacher in the Engineering Institutes at Kiev and St. Petersburg, learning English by studying such mathematical works as our own English classic in the field of applied mechanics, Love's *Theory of Elasticity*. Driven from Russia by the Bolshevik revolution, he spent a brief period in Jugoslavia, arriving in this country in 1922. During his 5 years in industry, chiefly with Westinghouse, he organized the Applied Mechanics Division in the American Society of Engineers, now the most fruitful source of applied mechanics literature in the entire field. Since 1927, he has been educating engineers, not only the students at the University of Michigan and Stanford University where he has held increasingly important academic positions, but all practicing engineers who are concerned with the design of machines or structures. Obviously, there is material in this life for a full-length biography, and one may hope that Young will undertake it.

In making this collection, the editors have discarded "a few papers, the content of which was deemed to be of more technical than scientific interest." Engineers will make no complaint; they have a gold mine in the volume as published. In the eyes of the design engineer, however, it is Timoshenko's chief virtue that his work, however scientific, invariably has some concrete design application and, moreover, it has an application that the engineer can comprehend and utilize. While others delight in pure abstractions, Timoshenko does not scorn a concrete result or even a numerical answer. He always offers the bridge that we so badly need between pure mathematics and practical design. Through him and his able colleagues we have progressed from "mechanics" through "applied mechanics" to "engineering mechanics," of which Timoshenko is the great disciple.

Physically, this book is a thing of beauty, worthy of the man whose collected works it holds. Handsomely bound, with an attractive type face on excellent paper, the format is marred only by the use of Continental numerical punctuation in the English texts (3.000.000 for 3,000,000 and 0,742 for 0.742). This is an idiosyncrasy that will offend British readers no less than Americans and is inadequately explained by the fact that the book was printed in the Netherlands. The preface states that these papers "are reprinted as they were originally published, any corrections or additions appearing in the form of footnotes." Spot checks indicate that this verbatim reproduction has been carried out meticulously, with the exception of the unfortunate numerical punctuation mentioned. The absence of a single corrective footnote in the entire 642 pages shows the care with which the original papers were prepared and proofread by the author.

This is a volume that any mathematician or any mathematically literate engineer or scientist should be happy to own. It could be used as a textbook, not so much in mathematics as in the art of scientific communication. It should be the *vade mecum* of every young scientist who aspires to express complex mathematical concepts in a manner that will help the designers of our machines and structures to create a better and safer world.

WILLIAM F. RYAN
Stone & Webster Engineering Corporation, Boston, Massachusetts

Die Welt der ungewohnten Dimensionen. Versuch einer gemeinverständlichen Darstellung der modernen Physik und ihrer philosophischen Folgerungen. Arnold Hildesheimer. Sijthoff, Leiden, 1953. 368 pp. Illus. + plate. Fl. 17.90.

This book on modern physics written in German is for the intelligent layman, defined in this case as a person possessed of at least 10 grades of Central European primary and secondary schooling. A native of Germany and a citizen of Israel, Hildesheimer is a broadly educated industrial chemist with considerable professional success in both countries. According to the biography on the dust jacket, he must have received his doctor's degree about 1910. In other words, although not an active participant in the development of contemporary physics, he has had full professional education and experience in a neighboring field. The book shows that the author also has maintained an active interest in philosophy and, more particularly, the philosophic implications of modern physical theories.

The author's background is pertinent to this review insofar as the writing of a nontechnical book on modern physics and modern epistemology is a highly personal business. To what extent prospective readers will enjoy such a book will depend to some extent on the degree to which they are "in resonance" with the author's approach, given factual competence.

Apart from an introductory section, which deals with the nature of scientific knowledge and its limitations, the book devotes approximately 100 pages each to three parts concerned with classical physics, relativity, and quantum theory, respectively, and about half as much space to a concluding (fourth) part on epistemological implications. According to the various prefaces, the book was read in whole or in part by W. Heisenberg, Gall, a teacher of mathematics and physics at Haifa, and Max Born, O. R. Frisch, and H. Groot. This battery of distinguished readers is both

guaranty and testimony for the fact that this book is not the work of a dilettante but of a competent and serious person who worked hard and well on both the scientific and the educational aspects of his undertaking.

In his preface, Hildesheimer claims that most of the semipopular books written by others deal either with quantum physics or with relativity but not with the whole of modern physics; moreover, those written by eminent scientists, such as Einstein, are not really comprehensible to the layman. I tend to disagree with these judgments. I distinctly recall that, as a young boy in secondary school, I read several books on relativity, among them those by Bertrand Russell and by Einstein, and that Einstein's presentation made the best sense to me. Both Gamow (in the "Mr. Tompkins" series) and Einstein (in the *Evolution of Physics*, with Infeld), have balanced their respective presentations. One thing may be said against Hildesheimer's work: like most scientists not themselves active in the field, he is overly impressed with the present accomplishments of physical theorizing. There is a great deal of discussion of controversial material of an epistemological character, although there is no mention of the Einstein-Rosen-Podolsky experiment and the ensuing discussion by Bohr and others. There is no discussion at all of quantum field theory and, more generally, of the relationship between relativistic field theory and quantum theory. But these topics should be of interest to the layman who is interested in the frontiers of science as well as its philosophic implications.

All in all, Hildesheimer's book will be of interest to those who read German fluently and who find it useful to read several semipopular books on modern physics by authors with different points of view. Such readers will find Hildesheimer's book well written and easy to understand.

PETER G. BERGMANN

Department of Physics, Syracuse University

Progress in Nuclear Physics. vol. 3. Otto R. Frisch, Ed. Academic Press, New York; Pergamon Press, London, 1953. 279 pp. Illus. + plates. $9.50.

This excellent volume contains a number of articles on topics in nuclear physics. The editor has apparently made the decision to keep the area covered by each author well circumscribed, permitting a rather detailed and complete review of each subject. This makes the volumes of this series complementary to its American analog, *Annual Review of Nuclear Science*, where on the whole fairly large areas are brought into perspective by a necessarily qualitative discussion.

The present volume contains a number of articles on instruments: "The diffusion cloud chamber" by M. Snowden; "Energy measurements with proportional counters" by D. West; "Solid conduction counters" by F. C. Champion; and "The production of intense ion beams" by P. C. Thonemann. Articles that have to do with nuclear physics proper are "Oriented nuclear systems" by B. J. Blin-Stoyle, M. A. Grace, and H. Halban; "Stripping reactions" by R. Huby; and "The collision of deuterons with nucleons" by H. S. W. Massey. Two topics on electrodynamics also included are "Cerenkov radiation" by J. V. Jelley and "Annihilation of positrons" by M. Deutsch. These are, of course, not properly nuclear physics; but the first has instrumental applications, while the second is of a most fundamental importance, providing sensitive tests of quantum electrodynamics as applied to the two-body problem.

It is a pleasure to record that these articles are well written, are authoritative, and for the most part are complete. The instrumental papers include sections detailing the theory of the instruments as well as giving experiments either already performed or twinkles in the eyes of the author, in which the instrument is used. We must exclude the discussion of solid conduction counters from this description, since it is hard to make them reliable. Here the author concentrates on the information of the structure of materials revealed by these investigations. The papers on nuclear physics proper present both the theory and the experiment and are careful to point out the possible experimental and theoretical avenues where further work is indicated.

The book contains a name index as well as a short subject index. Each article contains an extensive and, in itself, an extremely useful bibliography.

HERMAN FESHBACH

Department of Physics,
Massachusetts Institute of Technology

Progress in Cosmic Ray Physics. vol. II. J. G. Wilson, Ed. Interscience, New York; North-Holland, Amsterdam, 1954. xi + 322 pp. Illus. $8.50.

Like its predecessor, which was published in 1952, this volume consists of surveys or reports on several topics of current interest in cosmic-ray physics, written by experts in the fields covered. The usefulness of thoughtful reviews, expeditiously published, is quite obvious in such a turbulent subject; research workers will expect to find here many facts and references, collated with critical judgment, and in general they will not be disappointed. The book is satisfactory; if it misses the high level of some of the contributions in volume I, the differences are mainly that the subjects are less uniformly interesting, and the delay between writing and publication has stretched to well over a year.

The latter fact is most keenly apparent in the chapter on the heavy unstable particles. The editor has assigned himself this task and, in summarizing the experimental facts and their interpretation, has followed fairly closely the sense of the Copenhagen conference of 1952. The past year has seen some of that interpretation swept away, as new facts have clarified many difficult points (and of course raised others).

R. D. Sard and M. F. Crouch, writing on nuclear

interactions of stopped μ mesons, have presented an admirable survey of the experimental facts and have emphasized the crucial role of nuclear structure theory in obtaining quantitative results from the interpretation. (Again, the past year has seen the completion of an experiment that ingeniously avoids most of the uncertainties that nuclear theory introduces.) The late E. G. Dymond contributed an authoritative chapter on the penetrating component of cosmic radiation in the upper atmosphere and succeeded in bringing some order and rational interpretation into a nearly chaotic experimental situation.

The long chapter by H. Messel on the development of a nucleon cascade is a progress report rather than a true review. Messel's principal results are collected here and compared with experiment in a rather offhand way. One hopes that some method may be found in the future to reduce his formidable mathematical structure to a more convenient size.

The final chapter, "Particle identification with photographic emulsions, and related problems," by L. Voyvodic, presents a detailed exposition of the *expertise* of nuclear emulsions. Its inclusion is eloquent testimony to the importance of this tool in cosmic-ray research and helps to make the book a reference work of permanent value for physicists working in the field of cosmic rays and elementary particles.

R. W. Williams
Palmer Physical Laboratory, Princeton University

Flow Properties of Disperse Systems. J. J. Hermans, Ed. vol. V of *Deformation and Flow.* Interscience, New York; North-Holland, Amsterdam, 1953. vi + 445 pp. Illus. + plates. $9.90.

The term *disperse system* is used in this volume to cover not only suspensions and emulsions but also colloidal solutions, even though, in the latter case, many protein and polymer solutions are now known to behave like the solutions of small molecules. There are 10 chapters contributed by seven authors—five are from England, the others from France and Holland.

The editor shows that there is no thermodynamic necessity for dividing suspensions and solutions. A distinction is one of convenience. Hence, here are to be found the flow properties of dilute solutions of rigid particles, concentrated polymer solutions and gels as well as the coarser dispersions that include such a variety of systems as suspensions, emulsions, liquid sprays, smoke, and powders. The pertinence of the treatment to everyday technical experience can be illustrated by a brief selection of topics included in the volume: thixotropy, false-body, xerogels, rubber elasticity, viscosity with and without Brownian motion, non-Newtonian flow, drop size in liquid sprays, flow of a swirling liquid through an orifice, shattering of liquid drops by air blast, foams, coagulation of smokes, fluidized powders, free flowing and sticky. The volume is excellently produced, with legible type, equations and charts, and attractive reproductions of photographs. The reader has here in a single volume an authoritative summary of the rapidly developing science of rheology in these increasingly important systems of technology.

Hugh Taylor
Frick Chemical Laboratory, Princeton University

Modulation Theory. Harold S. Black. Van Nostrand, New York–London, 1953. 363 pp. Illus. + plates. $8.75.

The Bell Telephone laboratories have, of necessity, been vitally concerned with the systems approach to communication problems for many years because of its important economic bearing on the business of the Bell System companies. It is thus no accident that much of the pioneering work in this field by Nyquist, Shannon, and others, originated in that organization.

This recent volume in the Bell Laboratories series continues in the best of this tradition and is a valuable contribution to the science of communications. Heretofore, modulation theory has been treated in most textbooks and many articles from the point of view of apparatus design. This book is unique in that it considers modulation in the light of modern information theory, thus giving primary emphasis to the systems aspects of modulation.

The first third of the book is concerned with the generalized theory of modulation, particularly as it influences systems design. The latter two-thirds covers specific applications in the amplitude, frequency, and pulse modulation cases. The author avoids the distraction of excessive circuit minutia but includes practical illustrations, where required, in the form of simplified diagrams.

There is an excellent treatment of the various forms of pulse modulation, almost one-third of the text being devoted to this material. Although pulse circuitry and its associated techniques generally have become quite familiar to communications engineers because of the widespread use of radar, this broad discussion of all forms of pulse modulation will be found extremely useful and worth while to have in one place.

The material contained in *Modulation Theory* has been used in the communications development training program of the Bell Telephone Laboratories and makes an excellent textbook as well as a reference book. One of its most valuable parts is the list of references, numbering more than 300 in all, given at the end of each chapter. A number of problems are also included, which may be used by the student to check his understanding of the text. Although devoted entirely to modulation theory, the text is not excessively mathematical in nature, since the author wisely concentrates on the results of the mathematical processes and not on the details of the mathematical manipulations.

Harner Selvidge
Special Products Development,
Bendix Aviation Corporation

Physics for Medical Students. J. S. Rogers. Melbourne Univ. Press, Melbourne and Cambridge Univ. Press, New York, ed. 3, 1953. 405 pp. Illus. $5.50.

"Supplementary readings in physics for medical students" would perhaps be a more descriptive title for this book. As stated in the preface, the author proposes

> . . . to supplement those textbooks which have been written for first year university students studying for degrees of Science and Engineering. The aim has been to create interest by illustrating the principles of physics with application to physiology and medicine. . . . A somewhat full treatment has been given to those parts of the subject which appear to be of importance to a medical graduate, particularly to one interested in research where physical principles are involved.

In carrying out his purpose, the author does not "slant" the treatment of the subject so as to appeal exclusively to the medical student. The topics considered and the methods of approach stand on their own merits as sound basic physics.

The first edition of this book appeared just 20 years ago. In 16 chapters it covered an equal number of topics, including an outline of the historical development of physics. The present edition includes this early material, practically unchanged, together with 10 additional topics and chapters. The new material is concerned with the recent developments and applications of physics. Some of the chapter headings and topics taken at random are as follows: III, "Osmosis"; IV, "Surface phenomena"; VI, "Blood pressure and its measurement"; VIII, "The measurement of body temperature"; XII, "The human eye"; XVII, "Electrons, thermions, and thermionic valves"; XIX, "The electron microscope"; XXII, "Modern methods for the acceleration of ions to high energies"; XXIV, "Atomic energy"; XXVI, "Therapeutic use of x- and gamma rays."

Each chapter is a unit within itself and may be read or studied without reference to previous chapters. Mathematical considerations are simple and have been kept to a minimum. Line drawings are good and are used freely. The general layout, sectioning, type size, printing, table of contents, index, and so forth, all add up to make a favorable impression on the reader. The book is free of glaring errors, typographical errors, and ambiguous statements. The references cited (two or three per chapter) are usually to books rather than to original literature. The subject of anatomical mechanics (that is, forces, levers, stresses) is not touched upon.

The medical student may find too little medicine in parts of *Physics for Medical Students,* but on the whole the author has succeeded in his purpose. All serious-minded students and teachers of elementary physics will find this little volume interesting and helpful reading.

LESTER I. BOCKSTAHLER
Department of Physics, Northwestern University

Inorganic Syntheses. vol. IV. John C. Bailar, Jr., Ed. McGraw-Hill, New York, 1953. 218 pp. Illus. $5.

The present volume is an excellent addition to this series. Detailed directions are given for 58 laboratory-size preparations, some of which describe more than one compound. Most of these substances are not available commercially.

The preparations are arranged according to the periodic group of the principal element, as in earlier volumes. For the first time, however, most of the halides have been grouped together in a systematic and useful chapter. A rather large number of phosphorus compounds are also described. The subject and formula indexes include the contents of volumes I, II, and III. This is very important, since closely related compounds may be found in different volumes, owing to the random fashion in which manuscripts are obtained.

Each preparation has been offered by an author who has had experience with it, and his work has been checked in another laboratory by a different group of chemists. The precautions that are necessary are clearly indicated. With reasonable care, the procedure is quite certain to give the yield and purity figures that are claimed.

The procedures described in *Inorganic Syntheses* are surely not the only ones, and they are probably not even the best procedures, if we allow for future developments. However, the distinct advantages of this book are that the methods have been both carefully selected and sufficiently studied so that they are of known dependability. In these respects, the book is heartily recommended to chemists.

C. E. ERICKSON
School of Chemistry, Ralph G. Wright Laboratory, Rutgers University

Bailey's Text-Book of Histology. Revised by Philip E. Smith and Wilfred M. Copenhaver. Williams & Wilkins, Baltimore, ed. 13, 1953. xviii + 775 pp. Illus. + plates. $9.

This well-known and widely used textbook, planned by the authors for use by first-year medical and dental students, continues to incorporate the qualities that have determined its popularity and utility in the past. The general plan of the book remains unchanged. A consideration of the structure and functions of the cell, augmented by brief evaluations of current histological and cytological methods of study of both living and preserved material, is followed, in usual sequence, by the fundamental tissues and organ systems. The present edition has been enriched without becoming burdensome by the inclusion of much significant data and illustrations from recently developed techniques for the analysis of cell structure and function.

The authors have utilized wherever possible a functional approach to the study of structure, thereby increasing interest as well as facilitating comprehension of otherwise difficult topics. Short statements of developmental processes clarify many subjects, but per-

haps a greater utilization of this device could be made. Interesting and informative electron micrographs, pertinent histochemical data, and observations on living and surviving cells enliven many sections. Key references to pertinent literature are placed at the end of each chapter, but although this procedure contributes to smoother reading, the student rarely can identify properly and rightfully the observations and contributions of the investigators.

Improvements in descriptive matter are notable in the consideration of nervous tissue, spleen, digestive system, placenta, and mammary and endocrine glands. A chapter on the organization of nervous tissue, long a unique feature of this book, clarifies this topic in admirable fashion. Every student should have access to such a lucid description before attacking this subject in the classroom and laboratory. A concerted attempt has been made to improve the illustrations. Six plates in color and 88 additional illustrations have been added. Still, many of the older and less informative figures could profitably be replaced by ones approaching more closely the appearance of structures as revealed to the student by his own microscope as well as by phase contrast and the electron microscope.

The authors have again recognized and retained the perspective of the student, thus permitting his easy acceptance of their style. This edition promises, as have its forerunners, to provide reliable aid and guidance to the beginner and, for the advanced student, a stepping stone into the many fields suggested for further study throughout the book.

A. J. RAMSAY

Daniel Baugh Institute of Anatomy, Jefferson Medical College

Synthesis and Metabolism of Adrenocortical Steroids. Ciba Foundation Colloquia on Endocrinology. vol. VII, W. Klyne, G. E. W. Wolstenholme, and Margaret P. Cameron, Eds. Little, Brown, Boston, 1953. 297 pp. Illus $6.75.

The main benefit of this Ciba Foundation colloquium undoubtedly derived from the informal shoptalk in which the eminent participants from Europe and America engaged. This publication of the set pieces has been forestalled by similar, albeit terser, accounts in the journals; therefore, the value of the present volume is measured mainly by its success in capturing the spirit of controversy that enlivened the discussions. In about 60 closely printed pages, the formal exchanges after each address are given verbatim, and in this respect the book fulfills its useful purpose. It has been helpfully edited and well indexed, and the contributions therefore comprise a series of trenchant reviews of selected aspects of steroid chemistry and biochemistry. The scope is wider than the title suggests, especially in the chemical section, which includes accounts of the substances accompanying cholesterol from various sources, of the chemistry of lanosterol, the stereochemistry at $C_{(20)}$, and the action of x-rays on solutions of steroids. Accounts of the synthesis of Δ^9-anhydrocorticosterone acetate and of the infrared absorption spectra of trisubstituted steroidal olefines acknowledge the important relationship of Δ^9-steroids with the 11-hydroxy corticoids.

At the colloquium the chemists could claim partial syntheses of all the then known adrenal hormones except Reichstein's compound C, and they reported new and practicable partial syntheses of cortisone. The biochemical discussions foreshowed achievements subsequently won: electrocortin was yet the evasive mineralocorticoid spot on a paper chromatogram, and synthetic methods involving microbiological hydroxylation at $C_{(11)}$ were just becoming feasible.

The book contains authoritative comments on the biological tests and on the capabilities of new physical methods of isolating and identifying corticoids.

A. G. LONG

14 Woodland Rise, Greenford, Middlesex, England

Miscellaneous Publications

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Technical Papers

Feather Papilla Stimulation by Progesterone*

C. S. Shaffner

Poultry Department,
University of Maryland, College Park

The presence of progesterone or a physiologically equivalent substance has recently been found in the blood of the fowl. Although in the hen there appears to be no equivalent of the mammalian corpus luteum, the presence of the corresponding secretion is clear (*1*). A new and interesting role may now be ascribed to progesterone in the fowl, the activation of the resting papilla of the feather.

Hens of comparable age, breed, and state of maintenance were defeathered in similarly selected regions of the breast and neck feather tracts. Eleven hens received, by intramuscular injection, 20 mg each of a progesterone solution (*2*), which is slowly absorbed and has a prolonged physiological action. Three comparable hens served as controls.

Egg production in the treated group ceased immediately after treatment, and upon examination 2 wk later, all treated birds showed full feather regeneration in the areas of the neck and breast that had been previously defeathered. All control birds failed to regenerate neck feathers, and regeneration was sporadic in the breast areas. The progesterone-treated hens, furthermore, showed many new incoming feathers in all regions of the body and proceeded to replace much of the plumage. An average of four primary flight feathers per wing were molted and replaced. It may be deduced from this occurrence that the new growth was from the progesterone-activated papilla and was not due to a stimulation of the resting papilla by the plucking of old feathers.

Progesterone administered to mature cocks caused the same kind of molt but to a less spectacular degree. This effect of progesterone in the male required no estrogen priming.

The initiation of new feather regeneration in birds has long been known to follow the administration of large dosages of thyroidally active material. Conceivably the observed action of progesterone could follow via a stimulation of the bird's own thyroid. Although this is recognized as a possibility, it is unlikely to be the case, since the time interval from the inception of treatment to the initiation of feather proliferation is similar in either treatment. Van der Meulen (*3*) reported that 7 to 8 days after hens were fed 2 to 20 g of desiccated thyroid powder they showed signs of a molt, which reached a maximal degree 14 to 25 days following treatment. In the present experiments, feather regeneration started 8 to 10 days following progesterone treatment, and the heaviest shedding of feathers occurred after about 2 wk. Furthermore, when molt is caused by increasing the circulating level of thyroxin, the structure of the feather is also affected. This was not found to be the case with the progesterone-treated birds. For the present, the effect of the steroid is, therefore, considered to be a direct one upon the feather papilla. The relationship of progesterone-induced molt to reproduction will be described elsewhere.

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* Scientific article No. A464; contribution No. 2544 of the Maryland Agricultural Experiment Station (Department of Poultry Husbandry).

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26 April 1954.

Failure of the Newborn Pig to Utilize Dietary Sucrose

D. E. Becker, D. E. Ullrey, S. W. Terrill, R. A. Notzold

Department of Animal Science,
University of Illinois, Urbana

An inadequacy of sucrose in a synthetic milk diet for the baby pig was initially observed by Johnson (*1*). In a recent report Becker *et al.* (*2*) confirmed the detrimental effects of sucrose for the newborn pig and postulated that the difficulty resulted from an inability of the newborn pig to cope with the glycosidic linkage. The observations of Newton and Sampson (*3*) indicate that a failure in the metabolism of fructose may also be involved in an elucidation of the observed effects.

Newborn Duroc pigs that were allowed to nurse their dams for 24 hr following birth were used for this study. Three litters were distributed among four groups as the pigs became available. The pigs were group-fed *ad libitum* for a 9-day period on the floor of a shelter that had not been used for swine within recent years. The ingredients of the diet, except for the specific carbohydrate which varied with treatment, are presented in Table 1. Preparation of the milk diet and management of the pigs were described previously (*2*). Reagent grade sugars were employed, and the invert sugar consisted of an equimolecular mixture of D-glucose and D-fructose.

The results of the study are presented in Table 2. With glucose as the carbohydrate, performance was very satisfactory in terms of weight gain and survival. Although one pig succumbed on the glucose diet, it did exhibit a weight gain prior to death. Pigs receiving glucose occasionally voided soft feces, but they never exhibited a characteristic diarrhea.

Table 1. Composition of diet fed.

Ingredient*	Percentage
Carbohydrate	56.58
Casein, vitamin-free	30.00
Corn oil	5.00
Methyl cellulose, 4000 cm/sec	1.00
Potassium phosphate, dibasic	1.55
Sodium bicarbonate	1.42
Mineral mixture 12†	4.45
Vitamin mixture 16†	+
Antibiotic mixture‡	+

* Ingredients were incorporated into a milk containing 20 percent solids.
† Becker *et al.* (2).
‡ A mixture of equal parts oxytetracycline HCl, procaine penicillin and bacitracin fed to supply 396.8 mg/kg.

On the sucrose or fructose regimen, all pigs failed to show body-weight gains. One pig fed sucrose and two pigs fed fructose survived the experimental period, although no increases in body weight were observed. Diarrhea was severe. Following 18 hr of feeding, pigs fed either sucrose or fructose showed severe diarrhea, although it was more acute with the former carbohydrate. The severity of the diarrhea progressed, with the pig becoming thin, weak, and unthrifty. Appetites remained excellent until the pig became moribund. Usually death followed, at which time the average loss in body weight was approximately 0.3 kg. All manifestations supported the view that the reaction to fructose was less severe than to sucrose.

In contrast to sucrose or fructose, pigs fed invert sugar showed satisfactory survival, being comparable to glucose-fed pigs. The single pig that died on invert sugar did exhibit a weight gain during the test. With regard to rate and efficiency of gains, the glucose-fed pigs were significantly superior ($P < 0.05$) to pigs fed invert sugar. The feeding of invert sugar produced an intermittent, moderate diarrhea.

Table. 2. Survival, growth, and feed data for baby pigs fed sucrose or related sugars.

Item of interest	Dietary carbohydrate			
	D-glucose	Sucrose	D-fructose	Invert sugar
No. of pigs	7	7	7	6
No. of deaths	1	6	5	1
Avg. time until death (days)	8.0	4.3	6.0	8.0
Avg. initial weight (kg)	1.24	1.29	1.33	1.29
Avg. final weight (kg)*	2.36	0.97	1.02	1.78
Avg. gain per pig (kg)	1.12	−0.32	−0.31	0.49
Solids intake per pig (kg)	1.53	0.43	0.61	1.46
Solids per kilogram gain (kg)	1.37			2.98

* Weight at death or termination of the test.

In view of the disastrous results with sucrose, the livability and weight gains recorded on pigs fed invert sugar indicate that the newborn pig lacks the ability to hydrolyze the glycosidic bond of sucrose. An intestinal sucrase accomplishes this feat in the older mammal. Hence, the presence and/or activity of such a carbohydrase in the newborn pig seems worthy of study.

A failure of the newborn pig to hydrolyze the glycosidic linkage between the fructose and glucose moieties of sucrose is apparently the primary factor in an explanation of the failure to grow and survive on diets high in this sugar. Assuming that a limited degree of hydrolysis could be accomplished, however, the inability of the pig to utilize fructose would probably restrict performance.

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19 April 1954.

Improvement in Low-Temperature Resistance of Sugar-Beet Seedlings Treated with Dalapon (2,2-Dichloropropionic Acid)

W. G. Corns

Department of Plant Science, University of Alberta, Edmonton, Alta.

An earlier communication of mine (*1*) reported improvement in frost resistance of parsnip tops sprayed with chemical growth substances in the fall. Similar subsequent field experiments during the autumn of 1953 did not show visible differences, probably because of a different complex of weather conditions. More recently Crane (*2*) has published observations on the effectiveness of 2,4,5-trichlorophenoxy-acetic acid in promoting growth of apricot fruits sprayed before frost.

This paper describes laboratory studies in which a sodium formulation of 2,2-dichloropropionic acid (Dalapon, Dow Chemical Co.) improved low-temperature resistance of sugar-beet seedlings grown and frozen under controlled conditions in replicated experiments.

Sugar-beet seeds of the variety Kuhn were planted in Petri dishes containing a measured amount of vermiculite, moistened to capacity at the outset with a standard volume of water or of chemical solution. The temperature was 21.5° to 22°C with the humidity at a high level during 6 days of incubation in a dark chamber. By this time seedlings had not yet stopped increasing in height.

The concentrations of Dalapon (acid equivalent) reported here had no visual adverse effect on the growth of seedlings. Table 1 summarizes data in support of this conclusion. There is, of course, consider-

Table 1. Emergence and shoot and root length of sugar-beet seedlings grown with water or with Dalapon solution. Mean values for three replications per treatment 6 days after planting.

	Check	Dalapon 4 ppm	Dalapon 8 ppm
Emergence (No. of plants from 40 seed balls)	54	54	53
Root length (mm)	49.6	47.4	47.4
Shoot length (mm)	52.9	51.8	53.5

able natural variation in growth of individual plants from seed balls within treatments, but there was no statistically significant difference in total measurements between treatments.

Following removal from the growth chamber, the dishes containing the seedlings were in some experiments placed intact on a slowly rotating shelf in a deep freezer. In other tests the shoots were first severed and their basal region pressed lightly in a horizontal position on widely spaced bands of 0.5-in. Scotch tape stretched across the top of a shallow box-shaped wire frame.

Dishes with contents were exposed for periods of the order of 30 min at −10°C. Isolated shoots required only about 5 min of rotation at this temperature to permit detection of the differences between survival of chemically treated and untreated plants. Appreciably longer exposures killed all plants.

Survival was recorded on a percentage basis within the first minute or two after removal of material from the freezer to room temperature. Frozen seedlings collapsed almost immediately, but unaffected ones survived for several days, either rooted in moist vermiculite without added nutrient or when transferred from the tapes to dishes of water kept at room temperature in the laboratory.

Of the two freezing techniques, the tape procedure gave least variability in amount of improvement from chemical treatment in different experiments. This method was free from probable discrepancies occurring during cooling of entire dishes and contents.

Table 2 summarizes data from some representative statistically analyzed experiments employing the tape technique during freezing periods. The conclusion can be drawn that highly significant differences in low-temperature resistance existed between chemically treated and untreated seedlings within different seed lots and when either tap water or distilled water was used in preparation of the experiments. At the same time, quantitative growth of the seedlings was apparently unaffected

Limited preliminary experiments with similarly treated Saunders wheat, Polish rape, Earliana tomatoes, and Redwing flax have shown no increase in low-temperature resistance of seedlings treated with Dalapon.

Table 2. Effect of Dalapon on low-temperature resistance of sugar-beet seedlings.

Expt.*	Replications	No. in each sample	Time†	Mean percentage survival after timed exposure at −10°C: Check	Dalapon 4 ppm	Dalapon 8 ppm
†1 1952 seed	3	30	*a*	43	76	77
2	3	20	*a*	45	80	80
3 1953 seed	8	25	*a*	52	81	—
			b	35	73	—
	8	25	*a*	59	74	—
4			*b*	44	65	—
			c	34	63	—

* Expts. 1, 2, 3: Tap water was used with these experiments; distilled water was used with expt. 4 for moistening the checks and for preparing the chemical solution.

† (*a*) Five minutes at −10°C before 2 or 3 min of observation at room temperature; (*b*) A second exposure of same material for 6 min at −10°C and removal to room temperature; (*c*) A third exposure for 7 min at −10°C.

Grateful acknowledgment is expressed to the University of Alberta, the National Research Council of Canada and the Federal Department of Agriculture who will provide assistance to extend this research. The Dow Chemical Co. has donated supplies of chemicals, and Canadian Sugar Factories Ltd. provided sugar-beet seed.

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15 April 1954.

Uranium Determination by Use of the Photodecomposition of Oxalic Acid

Harold H. Paige, A. E. Taylor, Robert B. Schneider

Chemistry Department, Idaho State College, Pocatello

The photodecomposition of oxalic acid in the presence of uranyl ion has long been used as a means of measuring light intensities. Leighton and Forbes (*1*) have shown that this reaction,

$$H_2C_2O_4 + (UO_2^{++})^* \rightarrow (UO_2^{++}) + H_2O + CO_2 + CO,$$

with photosensitized UO_2^{++} is very nearly quantitative. We have endeavored to determine microgram quantities of uranium by measuring the extent of decomposition of oxalic acid with varying quantities of uranium (*2*).

It has been reported in the literature (*3*) that 10^{-3} g/lit of uranium can be determined with the use of photoelectric photometers and spectrophotometers; 10^{-11} g/lit, by fluorometric means; and 10^{-3} g/lit, polarographically. These figures represent the limits of determination under optimum conditions. The method, as outlined here, has proved effective on solutions of known uranium concentration in the range

10^{-4} g/lit with a standard deviation of less than 10^{-5} g/lit.

Shallow pyrex dishes containing samples are placed in an enclosed space at a distance of approximately 4 in. from a battery of six Sylvania or G.E. 15-w germicidal lamps. The area of the light source is approximately 324 in.^{2}, and the area used for exposure of samples to this light is approximately 34 in.^{2} The germicidal lamps were chosen because 90 percent of the radiant energy is at the 2537 A line (*4*) where the quantum efficiency is about 0.60.

Five standards were prepared in 500-ml volumetric flasks as follows: 10 ml of 0.1*M* $H_2C_2O_4$ was placed in each flask, followed by the addition of 70, 50, 30, 10, and 0 ml of a standard uranyl nitrate solution (0.0117 mg U/ml), respectively. Each was diluted to the mark with demineralized water and thoroughly mixed.

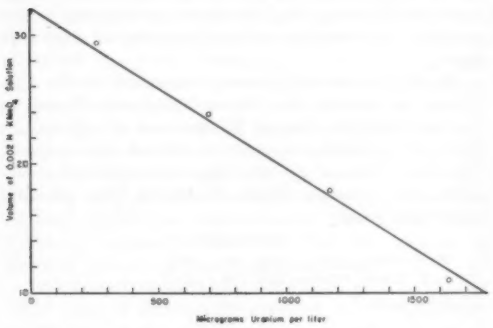

Fig. 1. Photodecomposition of oxalic acid as a function of uranium content of the solution (2-hr exposure; 2537 A radiation).

Eight 15-ml aliquots of each sample were exposed to the ultraviolet light for a period of 2 hr. After rinsing the samples into titration flasks, adding 5 to 10 ml 18*N* H_2SO_4, and diluting to 100 ml, the samples were titrated with a 0.002*N* solution of $KMnO_4$. The graph of Fig. 1 was made to serve as a standard curve. A new series of samples was prepared and treated as the others were, and the amount of uranium present was determined from this standard curve. Table 1 shows these data.

Although the accuracy and precision are good and the time required for a determination compares favorably with that of other methods, there are many variables yet to be studied, some of which are other light sources, time of exposure, ratios of uranium to oxalic acid, and interferences.

Table 1. Uranium concentration as determined by the photodecomposition of oxalic acid.

Uranium taken (μg/lit)	Uranium found (μg/lit)	Std. dev. in μg of uranium/lit
117	85	43
351	333	43
936	952	36
1287	1303	64
1521	1526	26

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6 April 1954.

Synthesis of Hexosamine by Connective Tissue (*in Vitro*)

Alfred J. Bollet, Norman F. Boas, Joseph J. Bunim

National Institute of Arthritis and Metabolic Diseases, National Institutes of Health, Bethesda, Maryland

Although labeled hexosamine has been found in streptococcal cultures (*1–3*), ovomucoid (*4*), and rat serum (*5*) following administration of C^{14} glucose, the synthesis of hexosamine has not been previously demonstrated in isolated animal tissue.

The method devised by Parker (*6*) for the study of antibody production *in vitro* was adapted to this problem. Using aseptic methods, dorsal subcutaneous connective tissue was obtained from rabbits that were sacrificed with ether. No attempt was made to obtain fat-free connective tissue, since fat did not interfere with determinations and the control samples used were of similar composition. Control samples were used to estimate the hexosamine content of the test samples before incubation (*7*). Tissue samples were cut into 1- to 2-mm fragments and incubated in 25-ml Erlenmeyer flasks after the medium was adjusted with 5 percent CO_2 in air to *p*H 7.8. Parker's ratio of 100 mg of tissue per 3 ml of medium was observed. Three-

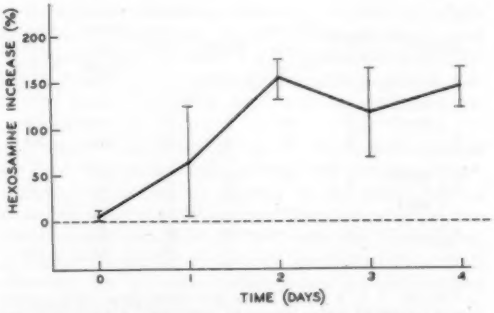

Fig. 1. Production of hexosamine by rabbit subcutaneous connective tissue cultured in Hanks' solution containing 25-percent ox serum ultrafiltrate. Vertical lines refer to standard error of the mean.

Table 1. Production of hexosamine by cultures of rabbit subcutaneous tissue.

Tissue	Medium	Hexosamine contents (mg)									
		3 days					4 days				
		Initial	Final			Change (%)	Initial	Final			Change (%)
		(tissue)	Tissue	Medium	Total		(tissue)	Tissue	Medium	Total	
Living	Hanks' solution	0.374	0.215	0.440	0.655	+ 75	0.263	0.166	0.450	0.616	+134
	with 25 per-	.492	.362	.393	.755	+ 54	.254	.253	.465	.718	+182
	cent ox serum	.366	.189	.171	.360	− 2	.215	.284	.312	.596	+177
	ultrafiltrate	.286	.344	.445	.789	+175	.234	.250	.380	.630	+169
		.251	.415	.497	.912	+263	.418	.217	.459	.676	+ 62
Heat in-	Hanks' solution	.450	.348	.084	.432	− 4	.400	.218	.119	.337	− 16
activated	with 25 per-	.398	.230	.087	.317	− 20					
	cent ox serum ultrafiltrate										
Living	Hanks' solution	.545	.565	.431	.996	+ 83	.193	.199	.370	.569	+191
	(with glucose)	.300	.232	.259	.491	+ 64					
Living	Hanks' solution	.355	.237	.175	.412	+ 16	.452	.239	.087	.326	− 28
	without glucose	.391	.273	.151	.424	+ 9					

hundred milligram tissue samples were divided equally into three flasks and were maintained without significant proliferation. All flasks contained 50 units of penicillin and 50 μg of streptomycin (*7a*) per milliliter of medium. At the end of the period of incubation, the sterility of each culture was established by subcultures on blood agar and Sabouraud's mediums. The tissue fragments were separated from the medium by filtration. The tissue residue and an aliquot of the medium were hydrolyzed in 2*N* HCl for 15 hr, and the total amounts of hexosamine were determined following their isolation on Dowex-50 (*7*).

Whole serum or embryo extracts could not be used as nutrients, since they contain relatively large amounts of hexosamine. Hanks' balanced salt solution (*8*), with or without ox serum ultrafiltrate, was used as the suspending medium, since both were found to be free of hexosamine; hence, the only hexosamine in the culture was the amount initially present in the tissue and that synthesized during incubation. The combined hexosamine content of tissue and medium was significantly increased after 48 hr or more of incubation in either medium (Fig. 1).

When the glucose was omitted from Hanks' solution, no increase in total hexosamine occurred (Table 1). When the tissue was inactivated by heating at 100°C for about 15 min prior to incubation, no increase in the total hexosamine occurred. In control cultures in which no synthesis occurred, hexosamine diffused out of the tissue into the medium, as was evidenced by the fact that the total hexosamine content of tissue and medium corresponded with that estimated to be present in the original tissue sample.

Histological studies made on tissues cultivated under the specified experimental conditions but not used for hexosamine determinations revealed that some necrosis occurred in the tissue fragments early and increased progressively during incubation. The progressive tissue damage may explain why most of the hexosamine production occurred in the first 48 hr.

Synthesis of hexosamine by rabbit synovial tissue was also demonstrated by incubating infrapatellar fat pads that are lined by synovial cells. No increase in hexosamine was found when muscle tissue was used.

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8 April 1954.

Toxicity to Pineapple Plants of Biuret Found in Urea Fertilizers from Different Sources*

W. G. Sanford, D. P. Gowing, H. Y. Young, R. W. Leeper

Pineapple Research Institute of Hawaii, Honolulu 2

During investigations involving the spraying of urea on pineapple plants, it has been observed that in some cases injury to the plants occurred. This injury consists of leaf-tip dieback, which is separated from the normal tissue by a zone of yellow tissue. Dieback varying from 1 to 12 cm has been observed. In extreme cases there has been yellowing of the edges of the lower leaves. In the past, the assumption has been made that under

certain environmental conditions and nutritional balance this injury was caused primarily by urea itself.

More recently a new lot of urea caused injury more severe than that observed with another lot of urea, in spite of the fact the plants were under identical environmental conditions and had the same nutritional status. This new lot of urea, along with urea from other sources and chemically pure urea, was analyzed to ascertain whether there were any differences in the amounts of contaminants present. The only major variation in chemical composition was in the biuret content. Biuret ($NH_2CONHCONH_2 \cdot 4/5H_2O$) (*1*) is chemically related to urea (H_2NCONH_2) and is formed on heating urea. Biuret was determined by the method of Robinson and Hogden (*2*) modified only in the manner of estimating the color intensity of the copper-biuret complex. The absorption spectra of the copper complex of biuret synthesized according to Haworth and Mann (*3*) and of biuret in different ureas were identical, maximum absorption being at 560 mμ determined in a Beckman model DU spectrophotometer, in agreement with that previously obtained (*2*).

In order to compare the effect of urea fertilizers from various sources with the effect of synthetic biuret on pineapple plants, a preliminary test (two replicates per treatment) was made. Table 1 presents the treatments, the amounts of biuret found in urea from various sources, and the relative toxicity of these products. Toxicity is measured in terms of amount of leaf-tip dieback and chlorosis. Application of the urea in this test was made on 14 July 1953 to 40 7-mo-old pineapple plants per treatment. Toxicity measurements were made 2 mo later.

The results from this test indicated that there was a positive correlation between the toxicity symptoms and the amount of biuret, whether added to the urea or present as a contaminant. Urea containing 3 percent or more of biuret produced dieback and yellowing. A spray containing biuret alone also produced dieback and leaf yellowing.

Table 1. Effect of biuret and of urea from different sources on chlorosis and leaf-tip dieback of pineapple plants.

Urea		Biuret ($NH_2CONHCONH_2 \cdot 4/5H_2O$)					
		Contaminant		Added	Total		
Source	Rate* (g/40 plants)	Content (%)	Rate (g/40 plants)	Rate (g/40 plants)	Rate (g/40 plants)	Average chlorosis index†	Average leaf-tip dieback (cm)
C.P.	270	Trace	Trace	0	Trace	55	0.0
A	270	0.4	1.1	0	1.1	50	.0
B	270	3.0	8.1	0	8.1	63	2.5
C.P.	270	Trace	Trace	16.3	16.3	83	3.5
C	270	6.0	16.3	0	16.3	95	4.0
No urea		0	0	32.4	32.4	100	4.3

* Applied as a 4.2-percent aqueous solution.
† Chlorosis index: the higher the number, the yellower the plant.

Biuret injury from urea foliar sprays has not been reported in the literature so far as is known to us. Experiments conducted in the USDA by Armiger, Breen, and Starostka (*4*) indicated that soil applications of 30 lb of biuret nitrogen (73.6 lb of biuret) per acre decreased yield of perennial ryegrass in the first clipping but not in the second clipping.

The results of this preliminary test suggest that leaf-tip dieback and chlorosis of pineapple plants sprayed with urea are caused primarily by the biuret found in urea and not by urea itself.

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* Published with the approval of the director of the Pineapple Research Institute of Hawaii as technical paper No. 222.
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14 April 1954.

Crayfish-Reddening Effect of Vertebrate Adrenal Cortical Extract

Max Goldman and Patrick H. Wells

Department of Zoology, University of Missouri, Columbia

Adrenal cortical extract (ACE) has been observed to have a pronounced reddening effect upon crayfish pigmentation. A total of 361 locally collected crayfish [*Orconectes virilis* (Hagen)] ranging in length from 2.4 to 5.7 cm were kept in individual finger bowls, each containing 250 ml of tap water (*1*). The water was changed daily. Approximately half of these animals received daily dosages of 0.05 ml adrenal cortical extract (Upjohn, 50 dog units/ml) in the water, administered just after changing the water. The untreated animals remained as controls. After about 3 wk of ACE treatment, all the experimental animals appeared quite red or orange, whereas all untreated controls retained normal brown coloration.

Subgroups of experimental and control crayfish were kept at room temperature or at 4.5°C, were starved or fed bits of beef, had their eyestalks removed or remained unoperated as controls. Variations in these factors had little influence on the crayfish-reddening effect of ACE and, therefore, are not discussed in detail here. In these experiments, ACE did not significantly prolong postoperative life or alter the acceleration of molting brought about by removal of the eyestalks. Destalked crayfish treated with ACE strikingly exhibited the reddish coloration.

ACE-reddened animals were examined more closely with the aid of a binocular microscope at 40× magnification. Bright red chromatophores appeared to domi-

nate the field of observation. There remained scattered irregular dark patches, but many areas were completely devoid of any dark pigment. The effect was more pronounced on smaller animals but was noticeable on all crayfish that received ACE. Control animals exhibited normal chromatophore distribution, black chromatophores being prominent as well as those of reddish hue.

In order that the crayfish-reddening effect of ACE might be described more precisely, uropods were removed from normal crayfish and placed in water in spotplate depressions. The uropods from each animal were separated, one exopodite and one endopodite serving as the experimental material and their opposite members as the control. Each of the former received 0.05 ml of ACE in the water, while the controls received additional water or van Harreveld's balanced-ion solution (*2*). Both groups were examined at intervals with the aid of a compound microscope at 100× magnification. The entire experiment was repeated more than a dozen times. During a 12-hr observation period, no changes were observed in the colored chromatophores on ACE-treated uropods. The black chromatophores, however, became generally gray in appearance, and irregular patches of black granules appeared. The dark chromatophores appeared to have been bleached or denuded of pigment, without noticeable change in degree of pigment dispersion. No observable changes occurred in the chromatophores of control uropods. The crayfish-reddening effect apparently results from destruction of dark pigment, leaving unaltered red chromatophores to create the dominant visual impression.

Although the effect of ACE on arthropod chromatophores has not been reported previously, there is considerable published evidence that adrenal cortical substances may influence pigmentation in vertebrates. Desoxycorticosterone suppresses the formation of melanin, inhibits melanophore differentiation, and causes melanophores to degenerate in explants of chick-embryo skin (*3*). Black or brown rats turned gray as a result of dietary vitamin-B deficiency and resumed deposition of melanin upon adrenalectomy, but the effect is suppressed by exogenous ACE or desoxycorticosterone (*4, 5*). It has been observed for many years that human patients with Addison's disease show varying degrees of darkening or pigmentation, presumably as a result of adrenal cortical insufficiency (*6*). It seems reasonable to hypothesize that the adrenal cortical mechanisms that suppress or destroy pigment in vertebrates and in the crayfish are basically similar.

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12 April 1954.

Absorption of l-Glutamic Acid

Williamina A. Himwich

Thudichum Psychiatric Research Laboratory, Galesburg State Research Hospital, Galesburg, Illinois

The possibility that the salts of l-glutamic acid have a different physiological effect than the acid has been raised by Waelsch (*1*). Pond and Pond (*2*) reported that a given dose of the acid raised the plasma level of glutamic acid less markedly but over a longer period of time than did an equivalent dose of either the sodium or potassium salt. Mayer-Gross and Walker (*3*) found that the oral administration of as much as 100 g of l-glutamic acid hydrochloride was not efficacious in arousing patients from insulin hypoglycemia, whereas the administration intravenously of 20 g of glutamic acid as sodium glutamate was.

A survey of the literature on l-glutamic acid administered either to animals or to man shows that three forms of the compound have been used: the salt of sodium or potassium, the unneutralized acid, and the hydrochloride. These three compounds differ markedly in solubility (*4*) and, thus, might be expected to be absorbed at different rates. In order to test this hypothesis, equivalent amounts of the three compounds were given to human subjects in a fasting condition. Blood samples were drawn routinely before the ingestion of the test substance and at 30, 60, 90, 120, and 180 min afterward; in four cases samples were also taken at approximately 4 and 5 hr. Plasma glutamic acid levels were determined by the method of Prescott and Waelsch (*5*). Since 16 such tolerance tests had been completed previously with 15 g of the monosodium salt of glutamic acid in tomato juice and water (*6*), the same dosage level and mode of administration were used for the other compounds.

The unneutralized glutamic acid was given twice to each of four subjects who had previously shown typical responses to the administration of sodium glutamate. In the first test of the unneutralized acid, in each of the four subjects, it was given as a sludge with tomato juice followed by water *ad libitum*. It was felt, however, that the ingestion of the acid with or immediately after food would more nearly approach the condition existing in the treatment of mentally defective children and that the presence of food might aid in the solution and absorption of the acid. Therefore, in the second test the acid was given with a liberal breakfast of hot cereal, eggs, milk, tomato juice, and toast, with water being allowed *ad libitum*. In three cases, the administration of food with the acid raised the absorption slightly but not at all to a level comparable to that of the salt. In the fourth individual no rise in blood level occurred after ingestion of the acid with or without food. In only one case was there any indication of a delayed rise, even though in two cases blood was drawn as late as 5 hr after the ingestion of the acid. The rises in these cases with unneutralized acid are similar to those reported by Bessman *et al.* (*7*) with a dose of 1 g/10 kg of body weight. One subject who

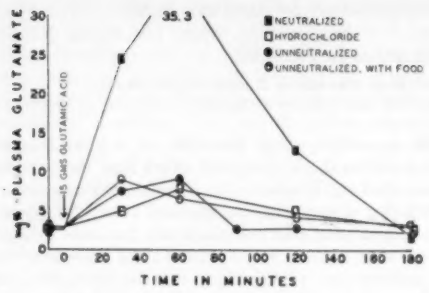

Fig. 1. 1-Glutamic acid tolerance curves on one subject with 1-glutamic acid compounds equivalent 15 g of the acid.

had nausea after taking glutamate experienced, none when given the unneutralized acid with or without food.

Two of the same subjects were used for one tolerance test each with glutamic acid hydrochloride. Because of the marked fall in blood pressure and the severe stomach cramps induced by the ingestion of such a large amount of this compound, no additional tests were undertaken. The hydrochloride was given to one subject in 50 ml of water followed by tomato juice and water *ad libitum* and to the other subject in capsules followed by tomato juice, and water *ad libitum*. It is interesting that the subject who received the capsules suffered acute nausea, the first time in six tolerence tests with various glutamic-acid compounds. In the subject who received the hydrochloride in solution, the rise in plasma level was somewhat greater than for the unneutralized acid; in the subject who received capsules, the reverse was true. The tolerence curves for the sodium salt, the unneutralized acid with and without food, and the hydrochloride for one subject are shown in Fig. 1.

It seems possible that the unneutralized glutamic acid is not absorbed to any great extent and that the major part of a given dose passes through the gut without going into solution. The material would not tend to dissolve in the acid *p*H of the stomach, and, although the duodenal secretions are alkaline, the intestinal contents, with the passage of acid chyme from the stomach, tend to be acid. Even in the absence of food, the passage of a substance as markedly acid as glutamic acid into the duodenum would tend to render that area acid, unless the glutamic acid at the same time stimulated a large flow of pancreatic juice. This latter possibility does not seem likely.

It is also possible that there is an extremely slow absorption of the unneutralized acid and that the blood level is elevated slightly over a comparatively long time. Our data do not suggest such an effect, but blood samples would have to be drawn over a much longer period of time to get a conclusive answer. However, in view of the normal pattern of variation of the plasma glutamate level (*6*) it does not seem likely that such a small rise would have much physiological effect.

Some of the confusion in the literature regarding the activity of 1-glutamic acid may be due in part to a failure of some investigators to specify which of the three forms of 1-glutamic acid they used. We can assume that 1-glutamic acid given by injection is close to *p*H 7.0 and, hence, is a salt of 1-glutamic acid, probably monosodium glutamate. Material given orally in solution is probably also a salt, unless otherwise specified, since the hydrochloride in solution has such unpleasant effects; the sludge is probably the unneutralized acid, and the capsules or pills may be any one of the three. The oral ingestion of 1-glutamic acid in a form that does not enter the blood stream readily cannot be expected to have any physiological effects. This situation emphasizes the fact that material placed in the gut is outside the body until it has passed the gastrointestinal mucosa. It is interesting that the majority of favorable reports of the results of administration of glutamic acid to patients or of its physiological effects in animals have been obtained with sodium glutamate or with the hydrochloride.

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5 April 1954.

Pseudo-B_{12} Activity in the Baby Pig

Jay Firth and B. Connor Johnson

Division of Animal Nutrition, University of Illinois, Urbana

Pfiffner *et al.* (*1*) have isolated an organism from rumen contents that produced cobalt containing pigments of the B_{12} group. One of these compounds, pseudo-vitamin B_{12}, has been isolated by the Parke-Davis group and shown to have B_{12} activity for *L. leichmannii, L. lactis dorner,* and *E. coli* but to be inactive for chick growth. Acid hydrolysis (*2*) of this pseudo-B_{12} indicates that it differs from B_{12} in that it contains adenine instead of 5,6-dimethyl benzimidazole in the nucleotide portion of the molecule. We have previously demonstrated a severe vitamin-B_{12} deficiency in the pig (*3, 4*), and the present experiment was made to find whether the adenine-containing form ("pseudo-vitamin B_{12}") would replace the benzimidazole-containing form in the nutrition of the pig.

Baby pigs 2 to 3 days old were used in this experiment. They were housed individually in wire-bottom metal cages and fed *ad libitum* an alpha-protein synthetic milk diet of the following percentage composi-

Table 1. Average weight response to vitamin B_{12} and pseudo-B_{12}.

	Basal + B_{12}	Basal − B_{12}	Basal + pseudo-B_{12}
No. of pigs	5	5	5
Avg. individual wt. (kg)	1.93	1.89	1.62
Avg. 4-wk wt. (kg)	10.19	5.13	5.06
Avg. gain (kg)	8.26	3.24	3.44

tion: alpha-protein 29.4; DL-methionine 1.3; cerelose 30.5; lard 30.5; minerals 8.3. A complete vitamin premix was added at the time of feeding with the exception of vitamin B_{12} or pseudo-vitamin B_{12}, which were given by weekly injection at the rate of 0.8 μ/kg of body weight per day.

Three groups of five pigs each were used. Weight gains for the B_{12}-deficient and pseudo-vitamin B_{12} groups were essentially equal for the 4-wk period, as is shown in Table 1. Erythrocyte, leucocyte, reticulocyte, and hemoglobin determinations were made every other day and were relatively equal for both the deficient and pseudo-vitamin B_{12} groups, showing a gradual decrease in red cells and reticulocytes. Injection of B_{12} produced an immediate appetite response in both groups, followed by a reticulocyte response in 8 to 10 days. Untreated pigs in the deficient and pseudo-vitamin B_{12} groups began to die of the B_{12} deficiency during the fifth week.

Pseudo-vitamin B_{12} is apparently inactive for the baby pig.

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14 April 1954.

Reversible Changes in the Absorption Spectrum of *Chlorella* upon Irradiation

L. N. M. Duysens*

Carnegie Institution of Washington, Department of Plant Biology, Stanford, California

When a suspension of purple bacteria is irradiated with visible or near infrared radiation, a change in the absorption spectrum occurs within one or a few seconds (*1, 2*). In the dark, the original absorption spectrum is restored within the same time. When the bacteria are photosynthesizing and the intensity of irradiation does not much exceed the intensity at which saturation of photosynthesis occurs, the difference between the absorption spectra in light and darkness is strikingly similar to the difference between the absorption spectra of oxidized and reduced cytochrome *c* (*2*).

This finding, combined with what was known about the photosynthesis of purple bacteria, strongly suggests that a cytochrome pigment is an intermediate in the photosynthetic oxidation of the reductant in purple bacteria. The question now poses itself whether in green plants the photosynthetic oxidation of the reductant—water—also is mediated by a cytochrome pigment.

We found that *Chlorella*, too, showed a change in the absorption spectrum upon irradiation, which was reversed upon darkening. This change was measured by a method similar to that used with purple bacteria (*1*). Red light ($\lambda > 670$ mμ) was used to illuminate the suspension, contained in a square cell, and the change in absorption brought about by this illumination was measured by a second, weak beam of variable wavelength at a right angle to the illuminating one. The optical density of the suspension, corrected for scattering, was about 0.5 at 680 mμ. The difference spectrum determined in this way is plotted in Fig. 1.

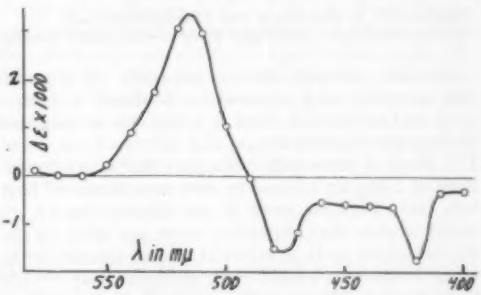

Fig. 1. Change in absorption spectrum of a *Chlorella* suspension upon irradiation with red light; Δε is change in optical density.

It shows a maximum, corresponding to a pronounced increase in absorption during irradiation, at about 515 mμ, and minima, indicating decreased absorption, at about 478 and 420 mμ.

Similar effects around 515 and 480 mμ were found also in a leaf, in the thallus of a sea alga, and in blades of *Vallisneria*. The region around 420 mμ was measured only for *Chlorella*. Thus it seems that the difference spectrum found for *Chlorella* is characteristic of green plants and algae in general.

As a whole, this spectrum of *Chlorella* cannot be identified with the difference between the absorption spectra of oxidized and reduced cytochrome *c* or *f*; it may, however, be the sum of two difference spectra: one belonging to a cytochrome, with the peak at 420 mμ, and one belonging to another pigment, with peaks at 515 and 478 mμ. If this is the correct interpretation, then the absorption drop at 420 mμ can be considered as revealing the oxidation of a cytochrome upon irradiation of *Chlorella* and its reduction in the dark. This would be in accordance with the suggestion of Hill and coworkers that cytochrome *f*, which they found in the chloroplasts of green plants (*3*) and in

Chlorella (*4*), functions in photosynthesis as an oxidation-reduction catalyst.

Further experiments are in progress to identify the pigment or pigments responsible for the irradiation effect on the absorption spectrum of *Chlorella*.

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* Present address, Photosynthesis Research Project, University of Illinois, Urbana.

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20 April 1954.

Negative Effects of Antibiotics on Thyroid Gland*

David A. Libby and Joseph Meites

Departments of Physiology and Pharmacology* and *Poultry Husbandry, Michigan State College, East Lansing

Recently Calesnick, Harris, and Jones (*1*) reported that penicillin and aureomycin produced a goitrogenic and antithyroid effect in young rats as indicated by increased thyroid weight and decreased uptake of I^{131}. Both of these antibiotics were fed in concentrations of 1 mg/kg of food to only two groups of four rats each. Previous work in our laboratories (*2, 3*) failed to show that antibiotics exert any effect on the thyroid gland itself in either thiouracil-treated chicks or in Protamone-treated rats, although body weight losses produced by these drugs were partially counteracted by the use of antibiotics. Inasmuch as antibiotics are widely used in human and animal practice, it was considered important to determine further whether they could alter the activity of the thyroid gland.

Thirty immature male white rats of the Carworth strain were divided into three groups of 10 animals each and were fed a basal diet with or without antibiotics for 21 days as follows: (i) basal (*3*); (ii) basal and 50 mg/kg potassium penicillin G; (iii) basal and 50 mg/kg aureomycin. On the 21st day, and 16 hr prior to sacrifice, each rat was injected intraperitoneally with 1.0 μc of I^{131}. The thyroids were removed, weighed on a Roller-Smith balance, and counted for radioactivity by the standard procedure. In another phase of this study, 20-day-old White Leghorn cockerels were divided into two groups of 10 each and fed the following diets: (i) basal (*2*); (ii) basal and 2 g/ton pencillin. At the end of 5 wk, the chicks were killed and the thyroids were removed and weighed. Radioactive iodine was not given to the chicks.

It can be seen in Table 1 that neither penicillin nor aureomycin altered the size of the thyroids or the uptake of I^{131} by the young rats, although both antibiotics increased body weight. Penicillin also failed to alter thyroid weight in the chicks, but it did not affect body weight. An additional group of 10 chicks was fed 90 g of arsanilic acid per ton of feed, and this substance also failed to influence thyroid weight.

Thus, we have not been able to confirm the claim that penicillin and aureomycin are goitrogenic or decrease the uptake of I^{131} by the thyroids of young rats, even though 50 times more of these antibiotics was fed to our rats than in the experiment reported by Calesnick *et al.* (*4*). Neither was it possible to demonstrate any antithyroid action by penicillin in chicks. In general, these findings are in agreement with previous indications of a lack of direct action by antibiotics on the thyroid gland (*2, 3*).

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* Published with the approval of the Director, Michigan Agricultural Experiment Station, as journal article No. 1635.

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7 April 1954.

Table 1. Effects of antibiotics on thyroid gland of five groups of 10 animals each.

Treatment	Avg. body weight		Avg. thyroid weight		I^{131} uptake (c/sec mg thyr.)
	Start (g)	Final (g)	Actual (mg)	per 100 g B.W. (mg)	
Rats					
Controls	82	157	13.1	8.35 ± 0.97*	185.6 ± 64.4*
Potassium penicillin G	83	168	14.1	8.42 ± 1.85	174.1 ± 74.1
Aureomycin	83	199	14.8	7.47 ± 0.99	233.8 ± 52.9
Chicks					
Controls	36	434	32.8	7.56 ± 1.27	
Penicillin	36	402	26.0	6.46 ± 0.61	

* Standard error of mean.

Communications

Origin of the Word *Climate*

According to *Webster's New International Dictionary* our word *climate* comes from the Greek κλίμα, which meant "inclination, the supposed slope of the earth toward the pole." Several editions of *The Encyclopaedia Britannica* make essentially the same statement but add, "or the inclination of the earth's axis."

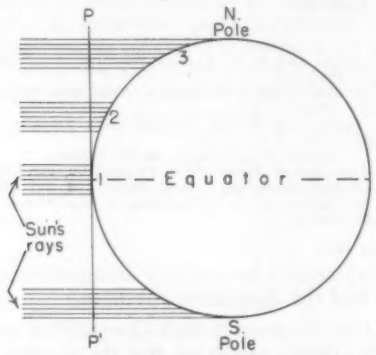

Fig. 1. This relationship of the sun's rays to the equatorial plane is an average for a full year.

A current textbook of geology states categorically that the word *climate* commemorates one of the oldest scientific discoveries, that the earth's axis is inclined to the ecliptic. Which of these two widely different interpretations has the better basis?

My good friend G. Lincoln Hendrickson, Professor Emeritus of Latin and Greek Literature, kindly examined early writings for clues to an answer. Ptolemy of Alexandria, the well-known mathematician and astronomer of the second century A.D., divided the world into κλίματα, a succession of zones from the equatorial region poleward, differing in the obliquity of the sun's rays to the earth's surface within the several zones. Ptolemy inherited this concept from earlier scholars; Eratosthenes, of the third century B.C., probably was the true inventor. His κλίματα were not conceived as contiguous zones but as a series of average latitudes. Hipparchus, of the second century B.C., tried to replace this rough concept by a more definite idea of latitudes. No doubt he saw that a change in latitude means a change in atmospheric conditions as well as in length of day. Probably the present meaning of *climate* developed gradually; but it is significant that divisions into torrid, temperate, and frigid zones still are made formally by parallels of latitude, although climatic belts in the modern sense are highly irregular in form.

The globular shape of the earth was common knowledge among Greek scholars from an early date, and presumably the general concept represented in Fig. 1 would have been acceptable to Hipparchus. On the average the sun's rays come to us parallel to the equatorial plane, or perpendicular to *PP'*. Bands with equal cross section are spread more and more, on the curving surface of the earth, with increasing distance from the equator. To the Greeks, belts 1, 2, and 3 would have been in different *climates*, on the basis of the angle between the solar rays and the earth's surface. Differences in the angle are the primary reason for different climatic conditions in the modern sense also. The inclination of the earth's axis has only a secondary, modifying effect on climates.

Analysis, then, favors the interpretation that the Greek κλίμα referred to the increasing slope of the earth's surface away from the equator. Perhaps the rival theory, that the inclination of the earth's axis was intended, has arisen from the literal translation of the Greek term.

My attention has been called to an exhaustive study of "the seven climates. . . ." in a book by Ernst Honigmann, published in Heidelberg by Carl Winter, 1929. This work was reviewed by George Sarton in *Isis*, 14, 270, (1930). The evidence presented in this book strongly supports the conclusion given here on the origin of *climate*.

CHESTER R. LONGWELL
Department of Geology, Yale University, New Haven, Connecticut

19 July 1954.

Occurrence of Mutarotase in Animals: Its Proposed Relationship to Transport and Reabsorption of Sugars and Insulin

Mutarotase previously demonstrated in molds (*1*) occurs in animals. One milliliter of a centrifuged homogenate of 1 g organ per 4 ml phosphate buffer 0.025*M* *p*H 7.1 was diluted to 25 ml with buffer, and the mutarotation rate constant *K* of 0.21 g of a freshly dissolved sugar was measured at 24°C in the photoelectric polarimeter #2, described by Keston and Lospalluto (*2*), attached to the Beckman DU spectrophotometer. D-xylose (A), d-galactose (B), arabinose (C), and d-glucose (D) were found to be substrates of rat kidney mutarotase, the ratio *K* catalyzed/*K* uncatalyzed being, respectively, 1.6, 4.2, 1.9, 4.3. L-rhamnose (E), d-mannose (F), and d-arabinose (G) were not substrates, and this ratio was 1.0 for these sugars. *K* (uncatalyzed) for the seven sugars mentioned was, respectively, 0.23, 0.12, 0.31, 0.071, 0.30, 0.34, and 0.30 min^{-1}. Sorbitol (H), mannitol (I), sucrose (J), and raffinose (K) cannot mutarotate and were unaffected. Phlorizin (0.9 mg/ml) was strongly inhibitory (about 90 percent) for all substrates. Rat liver contained about one-third as much per gram as kidney. Other organs and blood plasma contained little or no activity. Kidney extracts from hog, rabbit, chicken, rat, beef and lamb contained large amounts

of activity. The enzymic nature of the activity is indicated by its nondialyzability, thermolability (destruction at 60°C for 2 min), and optical specificity.

Of the sugars and derivatives studied here only mutarotase substrates have been reported to be "actively" reabsorbed by kidney (A,B,D) (*3*) or transported across cell membranes in response to insulin (A,B,C,D) (*4*). The nonsubstrates are reported not to be reabsorbed (H,I,J,K) (*3*) or thus transported (E,F,G,H,J) (*4*). Furthermore, phlorizin inhibits mutarotase at concentrations found in kidney (*5*) in "phlorizinized" animals. In such animals glucose reabsorption and oxidation (*6*) are blocked. The phosphorylation theory of glucose reabsorption is considered defective in that too high concentrations of phlorizin are required to inhibit kidney phosphatases.

A unitary theory of sugar transport applicable to transport of sugars into cells in response to insulin and reabsorption of sugars by kidney follows. Mutarotase in kidney catalyzes interconversion of various forms of sugar toward the equilibrium mixture during passage of the blood filtrate down the tubules. A preferentially absorbed form (PAF) of sugar passively diffuses into blood, where it must be present in lower concentration. As the filtrate continues down the tubule more PAF is produced by action of the enzyme and reabsorption proceeds. Since blood returning to the kidney must contain lowered concentrations of PAF, the theory demands that it be the same form that penetrates into cells in other parts of the body. Since insulin controls the transport of many sugars across cell membranes (*4*), mutarotase activity may be related to this action of insulin. PAF is probably neither the alpha nor the beta form of the sugar, since these are unquestionably present in sufficiently large amounts in many experimental situations where sugar transport occurs in response to insulin prior to addition of the hormone. It is suggested that PAF is a form of low abundance similar to or identical with the polarographically demonstrable mutarotational intermediate (*7*). Mutarotase, by controlling the rate of formation of a form of low abundance that penetrates into cells or that is a substrate for other enzymes, would control an important rate-limiting step in carbohydrate metabolism. Significantly, since the mutarotational system is going toward equilibrium, it is exergonic, the tubules are not required to expend energy, and the transport process although enzymatically controlled cannot properly be referred to as an "active" one.

Spontaneous uncatalyzed mutarotation could conceivably contribute to sugar transport to some degree in proportion to its rate and might become more important in organisms where metabolism or filtration rate is extremely slow. Fructose mutarotates at a much higher rate than glucose, and this may be a factor in its more effective utilization in diabetics.

The proposed theory suggests an involvement of mutarotase in diabetes mellitus and renal and phlorizin diabetes.

Experiments are in progress that are intended to elucidate a relationship between mutarotase and insulin.

Mutarotase occurs in animals, particularly in kidney, and is strongly inhibited by phlorizin. Sugars that are "actively" absorbed by kidney or transported across membranes into cells in response to insulin are mutarotase substrates. A unitary theory relating mutarotase to insulin and to sugar transport and reabsorption is described here.

ALBERT S. KESTON
New York University College of Medicine
New York 16

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19 July 1954.

Fire and the Australopithecines

In 1948, Raymond A. Dart [*Am. J. Phys. Anthrop.* **6**, 259 (1948)] announced that the so-called "manapes" of South Africa, the Pleistocene Australopithecinae, were fire-users. Dart's claim rested on the supposed evidences of fire, in the form of ashes and charred bones, found at Makapan in association with the fossil remains of a newly-discovered variety of Australopithecine, which he consequently dubbed *Australopithecus prometheus*. Whether or not the Australopithecines actually employed fire is an important question when assessing their zoological status.

Owing to an unfortunate alteration, my brief report of Kenneth P. Oakley's studies of the geologic dating of the Australopithecinae [*Science* **119**, 863 (18 June 1954)] conveyed the erroneous impression that Oakley was inclined toward the view that these animals actually made use of fire; whereas, in fact, his position was quite the contrary. The printed sentence of my report, "Nor does the evidence support claims that the Australopithecines made any sort of tools, although they may have used ready-to-hand tools and weapons *or may have been fire-users*" (italics mine) should correctly read "Nor does the evidence support claims that the Australopithecines made any sort of tools (although they may have used ready-to-hand tools and weapons) *or were fire-users*" (italics mine).

Oakley's [*Am. J. Phys. Anthrop.* **12**, 9 (1954)] full statement on this point follows:

> The doubtful evidence of fire in the *Australopithecus* layer at Makapan is still *sub judice*, and even if confirmed could most readily be accounted for by a natural grass fire outside having ignited inflammable bat-guano at the entrance to the cave—there are in fact records of comparable fires having occurred in recent times.

This agrees with his earlier statements [in *An Appraisal of Anthropology Today*, Tax *et al.*, Eds. (Univ. of Chicago Press, 1953), pp. 29–30; *Weekly Evening Meeting Roy. Inst. Gr. Brit.* (20 Nov. 1953)] that the blackening of bones found at Makapan is due to manganese dioxide and is not due to charring, as claimed by Dart; furthermore, the other supposed indications of fire associated with the remains of *A. prometheus* were so equivocal as to leave Oakley unsatisfied that there was any evidence of hearths in that geologic layer.

Thus Oakley's critical studies of the Makapan material reveal *A. prometheus* as an unfortunate misnomer. Whatever the final verdicts regarding the posture, the cerebral status, and other moot characters of the Australopithecinae, it appears reasonably certain that these animals had not captured fire.

WILLIAM L. STRAUS, JR.

Laboratory of Physical Anthropology,
The Johns Hopkins University, Baltimore, Maryland

8 August 1954.

Noncytopathogenic Variants of Poliomyelitis Viruses and Resistance to Superinfection in Tissue Culture*

In the first successful propagation of poliomyelitis virus in tissue culture in 1936, the virus multiplied in the nervous tissues but not in the visceral tissues of the same human embryos (*1*). Ever since unequivocal multiplication in nonnervous tissue was demonstrated 13 yr later (*2*), it had been an intriguing question why the 1936 experiments with nonnervous tissue had failed. Recent experiments have demonstrated that intracerebral passage in monkeys favors the segregation of variants that are devoid of cytopathogenic activity for fibroblasts growing out of monkey testicles in tissue culture but possess full cytopathogenic activity for epithelial cells derived from monkey kidney (*3, 4*). More recently I have found that from the nervous system of infected animals it is possible to segregate variants that have no cytopathogenic effect on epithelial cells derived from monkey kidney (*5*).

Since the "MV" strain of virus that was used in the 1936 cultivation experiments had had a large number of intercerebral passages in monkeys, it appeared possible that it might be a variant that lacked the property of multiplication in nonnervous tissue. A specimen of this virus that had been frozen for many years was found to have no cytopathogenic effect on epithelial cells derived from monkey kidney in any dilution tested, although intracerebral inoculation produced typical paralytic poliomyelitis in a monkey. The freshly passaged virus also produced no cytopathogenic effect on monkey kidney epithelial cells and four blind passages failed to yield a cytopathogenic agent, although in the third and fourth passages a few epithelial cells degenerated and fell off the glass within 4 days after inoculation, whereas the bulk of the growth remained unaffected for 10 to 12 days.

Last year, I observed that a strain of MEF_1 suckling mouse-adapted poliomyelitis virus derived from the viral progeny in a single suckling mouse at the end-point of an intracerebral titration exerted little or no cytopathogenic effect on monkey kidney cells, but after an incubation period of 7 to 12 days the majority of the epithelial cells that had been exposed to the virus (in dilutions up to 10^{-7} to 10^{-8}) had become resistant to the rapid cytopathogenic effect of the parent strain.

Similar tests performed with the MV virus revealed that, after an incubation period of 10 to 12 days in roller tubes, the epithelial cells derived from monkey kidney had acquired a limited resistance to the cytopathogenic effect of 100 TCD_{50} of the homotypic, Type 2 Y-SK strain. At 2 days after challenge, the epithelial cells in the control tubes, as well as in the tubes that received the higher dilutions of the MV virus, were completely destroyed. The epithelial cells in the tubes inoculated with the lower dilutions of MV virus showed little or no change at 2 days, but at 4 days almost all the cells were similarly destroyed. This limited resistance was not observed when a mixture of the "MV" and "Y-SK" viruses was added to normal epithelial cells or when the Y-SK virus was added 1 hr or 6 days after the addition of the MV virus.

It should be noted here that strict neurotropic variants that have recently been segregated in this laboratory from Type 1 and Type 3 viruses have conferred no such resistance on epithelial cells derived from monkey kidney, but it is possible that the challenge viruses may not have been added at the right time. Further work on the mechanism of the resistance produced by noncytopathogenic variants of poliomyelitis virus would be of the greatest interest particularly with respect to the possible operation of a phenomenon comparable to that of lysogenic phage.

ALBERT B. SABIN

The Children's Hospital Research Foundation,
University of Cincinnati College of Medicine
Cincinnati, Ohio

References and Notes

* Aided by a grant from the National Foundation for Infantile Paralysis.

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3. A. B. Sabin, J. Winsser, and W. A. Hennessen, *Abstr. of Papers Presented at the VIth Intern. Congr. Microbiol.* **2**, 97 (1953).
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5. A. B. Sabin, *WHO Monograph Series, Symposium on Poliomyelitis*, in press.

2 August 1954.

Association Affairs

A New Home for the AAAS

On 4 August the District of Columbia Board of Zoning Adjustment gave the AAAS permission to erect a headquarters building on the Association's property at 1515 Massachusetts Ave. NW, in Washington. Members who have built their own homes and those who remember Mr. Blanding's dream house—whose author, by the way, gained additional laurels in 1953 in winning one of the AAAS–George Westinghouse Science Writing Awards—will have a sympathetic feeling both for the excitement of the occasion and for the fact that a good many headaches lie between permission to build and actual occupancy.

The model pictured here was built to show the Board of Zoning Adjustment the size and general character of the proposed building. The building itself will not necessarily match the model in all respects, for detailed drawings have not yet been prepared. The size, however, is definite. There will be three stories and a basement.

The new headquarters will provide approximately 3 times as much office space as does the old residence that the Association now occupies at 1515 Massachusetts Avenue. Such an increase should prove ample for as far ahead as we can safely predict our needs. As a matter of fact, for some years there is likely to be space available for one or two affiliated societies that want to move in with us. A ground-floor auditorium with a capacity of about 200 is a possibility but not yet a certainty.

The building will be modern in design and construction. The movable louvers shown across the front of the second and third floors constitute one of its most unique features. They are designed to shield the large glass areas from direct sunlight and will reduce substantially the cost of air-conditioning the building.

The Association's appearance before the Board of Zoning Adjustment on 30 July was its second attempt to secure permission to erect a headquarters building. An earlier effort in 1952 was denied. In making a second attempt, the Association changed its plans in a number of respects. Most important was the reduction in size from a building of eight stories to one of three. The larger building, planned to accommodate a number of affiliated societies as well as the AAAS, was too much for the Board of Zoning Adjustment to approve for construction in a residential area. The smaller building won their unanimous approval and will be adequate for the AAAS but may be a disappointment to those who had hoped that we could bring a number of scientific societies together under the same roof.

It will take several months to complete final plans and to make arrangements with a building contractor. Work can be expected to start in the early spring of 1955, and the building should be ready for occupancy approximately a year later. We can look forward, in 1956, to moving into our permanent headquarters, a building of our own design, and one that the Association has been talking about ever since the site was purchased in 1946.

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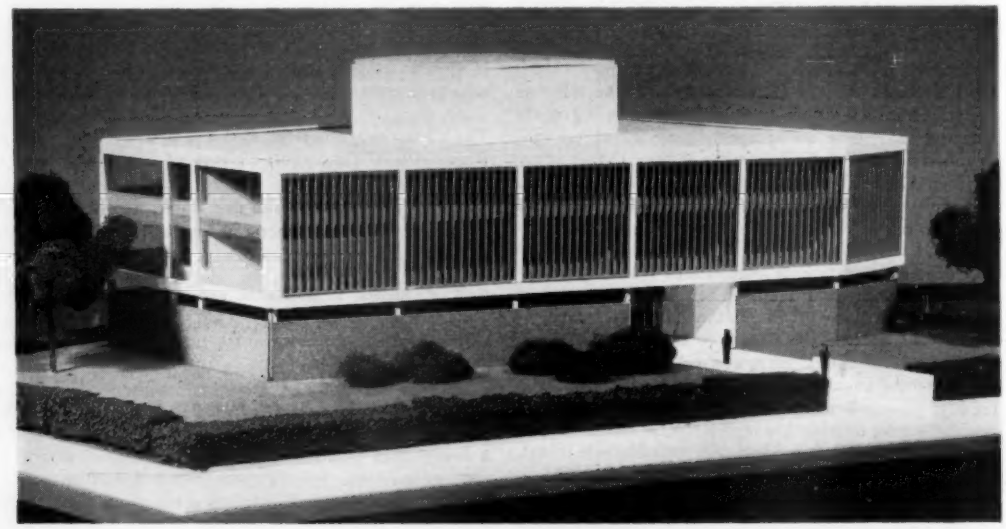
American Association for the Advancement of Science



Meetings & Conferences

September

19–24. American Acad. of Ophthalmology and Otolaryngology, New York City. (W. L. Benedict, 100 First Ave. Bldg., Rochester, Minn.)

21–23. Soc. for Experimental Stress Analysis, Philadelphia. (W. M. Murray, Central Square Station, P.O. Box 168, Cambridge 39, Mass.)

21–24. American Roentgen Ray Soc., Washington, D.C. (B. R. Young, Germantown Hospital, Philadelphia 44.)

22–24. Conf. on the Protection of Plants in Hot Climates, Marseilles, France. (P. Bonnet, Palais de la Bourse, Marseilles.)

22–24. Mississippi Valley Medical Soc., 18th annual, Chicago, Ill. (H. Swanberg, 209–224 W.C.U. Bldg., Quincy, Ill.)

22–28. International Symposium on High-Speed Photography and Kinematography, 2nd, Paris, France. (P. Naslin, Laboratoire Central de l'Armement, Fort de Montrouge, Arcueil, France.)

23–28. European Cong. and Clinical Chemistry, 1st, Amsterdam, Netherlands. (Ir. O. Meulemans, Racinelaan 17, Utrecht, Netherlands.)

24. American Medical Writers Assoc. 11th annual, Chicago, Ill. (H. Swanberg, Drawer 110, Quincy, Ill.)

24–25. International Symposium on Problems in Physiology and Pathology of the Eye, Iowa City, Iowa. (F. C. Blodi, Dept. of Ophthalmology, State Univ. of Iowa, Iowa City.)

24–27. International Soc. of Medical Hydrology, Vichy, Paris, and Enghien, France. (Dr. Francon, 55 Rue des Mathurins, Paris 8.)

26. Cong. of International Soc. of Medical Hydrology, Vichy and Paris, France. (G. Ammirandoli, Via Della Torretta 11, Montecatini Terme, Italy.)

26–2. International Union Against Tuberculosis, 13th, Madrid, Spain. (J. Aliz, Calle Francisco Silvela 20, Madrid.)

26–2. World Medical Assoc., 8th general assembly, Rome, Italy. (L. H. Bauer, 345 E. 46 St., New York 17.)

27–2. International Conf. on Engineering Education, 2nd, Switzerland. (L. A. Rose, Univ. of Illinois, Urbana.)

27–2. Symposium on Macromolecular Chemistry, Turin and Milan, Italy. (A. Nasini, Corso Massimo d'Azeglio 48, Turin.)

October

1–5. International Cong. of Chronometry, Paris. (R. Baillaud, Observatoire National, Besançon, France.)

2–6. International Cong. on Diseases of the Chest, 3rd, Barcelona. (American College of Chest Physicians, 112 E. Chestnut St., Chicago 2.)

3–5. Southern Psychiatric Assoc., Louisville, Ky. (G. Southerland, 2218 N. Charles St., Baltimore.)

3–6. World Medical Cong. of Homeopathy, 1st, Rio de Janeiro, Brazil. (R. Seidel, 1801 Porter St., Philadelphia, Pa.)

3–7. Electrochemical Soc., autumn, Boston. (H. B. Linford, Columbia University, New York 27.)

4–6. National Electronic Cong., 10th annual, Chicago. (K. Kramer, 852 E. 83 St., Chicago 19.)

4–7. American Acad. of Pediatrics, Chicago, Ill. (E. H. Christopherson, 610 Church St., Evanston, Ill.)

(See issue of 20 August for more comprehensive listings.)

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